Society 5.0

Integrating Digital World and Real World to Resolve Challenges in Business and Society

Society 5.0 2021

Proceedings of the

First International Conference on Society 5.0

Virtual Forum 22nd to 24th June 2021

Editors: Aurona Gerber & Knut Hinkelmann

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Preface

This proceedings contain the revised accepted papers of Society 5.0 2021, the *1st International Conference on Society 5.0*[1]. A selection of the best papers will be published in a volume of Springer CCIS.

Foreword

Dear authors and readers,

It is with great pleasure that we write this foreword to the Proceedings of the first International Conference on Society 5.0 (Society 5.0 2021), to be held as a virtual forum on 22nd-24th June 2021. In 2022 we hope the Society 5.0 conference will take place in Switzerland. We expect this multi- and interdisciplinary conference to grow into a premier conference series.

The annual conference series is jointly organized by the Universidad EAFIT (Colombia), the University of Pretoria (South Africa), University of Camerino (Italy), the Business School of the Shenzhen Technology University (China), the Universiti Malaysia Kelantan (Malaysia), Putra Business School (Malaysia) and the FHNW University of Applied Sciences and Arts Northwestern Switzerland.

Society 5.0 can be defined as a human-centered society that balances economic advancement with the resolution of social problems by a system that highly integrates cyberspace (virtual space) and physical (real) space. The aim of Society 5.0 is to create a society where social challenges are resolved by incorporating the innovations of the fourth industrial revolution (e.g. Internet of Things, Big Data, Artificial intelligence, and the sharing economy) into industry and social life. The term originated in Japan from the government?s Council for Science, Technology, and Innovation and it tackles any aspect of society like healthcare, mobility, infrastructure, politics, government, economy and industry.

Society 5.0 also involves the enormous opportunities and challenges of the 21st century. Problems such as climate change, migration and resource consumption must be solved jointly and globally. Sustainable Development Goals (SDGs) such as poverty and education require international efforts. Lessons learned from the Covid-19 pandemic can have an important impact on dealing with global challenges and crisis situations. Technological advancements and trends for digital transformation should assist us to address these global problems. Convergence of cyberspace and physical space can foster new forms of global cooperation. People, things, and systems are all connected in cyberspace. Results obtained by AI can exceed the capabilities of humans and are fed back to physical space.

The Society 5.0 conference series plan to include the entire range of high-quality research about these opportunities and challenges, as well as showcase solutions. The theme for Society 5.0 2021 is *Integrating Digital World and Real World to Resolve Challenges in Business and Society* .

We sincerely thank all or organizers, partners, authors and reviewers without whom this conference would not have been realised.

[1] https://www.conference-society5.org/

Technical Information

This Society 5.0 2021 online proceedings are published to support our virtual forum. The proceedings contain two volumes with the revised papers accepted for Society 5.0 2021. We are thankful that our first annual Society 5.0 Conference elicited the support it did during this challenging year with all the uncertainties due to the Covid-19 pandemic.

We received 54 submissions, which were sent out for review to our Society 5.0 programme committee. The programme committee comprised more than 60 members from across the world. Each paper was reviewed by at least three members of the programme committee in a rigorous, blind review process where the following criteria were taken into consideration: Relevance to Society 5.0, Significance, Technical Quality, Scholarship, and Presentation that included quality and clarity of writing.

For this Society 5.0 online proceedings, 15 full research papers were selected for publication in a Springer CCIS volume (which translates to an acceptance rate of 28%). These papers are included in Volume I. A further 21 papers were accepted for inclusion in an online proceedings volume, which amounts to an acceptance rate of 66% of all submissions. These papers are included as Volume II. The papers are listed alphabetically according to the surname of the first author.

Thank you to all the authors and programme committee members, and congratulations to the authors whose work was accepted for publication in this proceedings. We wish our readers a fruitful reading experience with these proceedings!

June 2021

Aurona Gerber and Knut Hinkelmann
Technical Co-chairs: Society 5.0 2021

Organization

The annual conference series is jointly organized by the Universidad EAFIT (Colombia), the University of Pretoria (South Africa), University of Camerino (Italy), the Business School of the Shenzhen Technology University (China), the Universiti Malaysia Kelantan (Malaysia), Putra Business School (Malaysia) and the FHNW University of Applied Sciences and Arts Northwestern Switzerland.

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Society 5.0 Proceedings
Volume I

Blockchain and IoT integration for Society 5.0

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Abstract. The integration of Blockchain and Internet of Things (IoT) will have many implications in the Society 5.0. Blockchain technology has the potential to deal with issues that are related to data ownership, data integrity and data market monopolies. Public blockchains support the implementation of the data democratisation vision where everybody has access to data and there are no gatekeepers that make use of isolated data silos. Smart contracts can be used to provide contract transparency and allow citizens to manage their own data and the deriving economic value. This paper describes a novel blockchain-based security protocol that has been applied to a bicycle rental case study. This has been designed and implemented with the Society 5.0 vision in mind. Users store their own rental data by using a public blockchain. This eliminates the need of a centralised authority, provides data immutability and allows users to agree on transparent smart contract to manage their insurance, their payments and their own rental data. The smart lock protocol has been implemented in a real industrial product that uses the Ethereum public blockchain.

Keywords: Society 5.0 · Blockchain · Internet of Things · Smart Lock · Smart Contracts.

1 Introduction

We are living in an era where the innovation of enabling technologies such as Internet of Things (IoT), Artificial Intelligence (AI) [16] and robotics will play a major role and bring new changes to economy and society. This view complies with the 5^{th} Science and Technology Basic Plan, that was adopted by the Japanese Cabinet in 2016. This introduces Society 5.0 [4, 12], a Japan's vision for the next step in human evolution after hunter-gather, agrarian, industrial and information society stages. It aims at enhancing industrial competitiveness and helping with the establishment of a society more attuned to individual needs. The focus is on the vast potential of accumulating data, and new technologies of the fourth industrial revolution, in order to find solutions to social issues such as the declining birth rate, an ageing population, and environmental and energy issues.

Essentially, Society 5.0 is an integrated human-centred ecosystem where people, IoT devices and systems are seamlessly connected. Data from IoT devices are analysed by AI and injected back into the society.

The vision of Society 5.0 cannot be realised unless problems of data monopoly, data abuse and data ownership are overcome [21]. To date GAFA companies (i.e., Google, Apple, Facebook, and Amazon) concentrate most of the data which worries about data monopoly and abuse. Data monopoly prevents small and medium enterprise the use of data for innovation. Data should be shared to the society for an effective use in the digital age. The effective use of data also requires the definition of its ownership. In the Society 5.0 vision [7] data should be controlled by its originator or available to everyone when there are no privacy concerns. Monopoly, abuse and ownership of data issues need to be solved in order to avoid the Society 5.0 to turn into a dark one [6].

Public blockchain technology [13, 20, 9] can be a viable solution for the aforementioned problems. Blockchain implements a distributed ledger where any participant can maintain secure transaction records, ownerships, and promises. Records can be kept immutable and secure by using distributed algorithms and cryptographic primitives without the need of a central trusted authority. Ownership is assigned to each account holder by using wallets. Modern blockchains such as Ethereum [2] also allow the definition of digital smart contracts. These allow users to execute, control and document legally important events and actions according to the contract terms or the agreement. Public blockchain data are available to everyone thus data monopoly is avoided. Smart contracts are public and can be used to make the users aware of the information they are exposing. This tames the problem of data abuse and create user awareness. Furthermore, the research community is also proposing new techniques to deal with privacy and confidentiality issues on blockchain [18]. Although Blockchain technology is a promising solution its applicability to IoT needs also to deal with some challenges. Smart contracts are run by miners which can result in slow execution time (e.g., 10 minutes to mine a Bitcoin block while 20 seconds to mine an Ethereum one) and expensive fees [9, 11, 5].

This paper presents a novel secure protocol which integrates users, blockchain, two or more contractors and IoT devices that are constrained in terms of CPU and memory. The protocol allows authorised users to perform operations on the IoT devices. Operations are securely logged on the public blockchain which provides immutability and allows the execution of smart contracts. These can be used for billing and data analysis purposes. Our protocol also deals with issues of blockchain scalability (in terms of transaction per seconds and fees) and user privacy. More precisely, the protocol allows real-time IoT device operations since it is not bound to the transaction speed of the main blockchain. User privacy is guaranteed since it is not possible to understand which users performed which operation from the public blockchain data. The protocol have been applied to an electrical bicycle (in the following referred to as ebike) rental industrial case study [10] which includes IoT smart locks, two contractors (i.e., Insurance and Service provider), the Ethereum public Blockchain and citizens. The rental ser-

vice is a human-centred one which complies with the Society 5.0 vision. Our secure protocol allows users to rent and pay securely ebikes. Smart contracts are used by the user, insurance and service provider to define an immutable and transparent smart contract which defines the rental and insurance price and the user data that will be publicly released. Thus, the user has a clear understanding of which data are made public. The use of blockchain also solves the need of a trusted party between service provider and insurance that is needed to bill the user per hourly use. Public blockchain data can be used by any specialised data analysis companies (i.e., data monopoly is avoided) to inject back into the society useful information such as fuel saved, reduced carbon emission and other customised information.

The novelty of this paper can be summarised as follow: (i) a novel blockchain-based protocol securely controlling IoT devices, running on small embedded devices, scaling in terms of transaction per seconds and having low fees; (ii) a real Society 5.0 case study where data are transparently stored and processed, and information is fed back into the society for social purposes.

The rest of the article is organised as follows: Section 2 provides some background on Ethereum; Section 3 introduces the requirements of the smart lock application; Section 4 details the secure protocol and the overall system architecture; Section 5 discusses the security of the protocol and its compliance with the Society 5.0 vision; Section 6 describes the related work; finally, Section 7 concludes the article and outlines future work.

2 Ethereum Background

A **blockchain** is a ledger that records transactions amongst parties in a verifiable and permanent way. The ledger is implemented in a distributed fashion by a network of nodes (often referred to as miners) that interact to write new transactions via a distributed consensus protocol [15]. This allows transactions to be replicated across several nodes thus making some attacks (e.g., modification) difficult. We focus on Ethereum [19] which allows the transfer of currency and the execution of **smart contracts**. These can be written by using a Turing-complete language. Smart contracts are applications that are run by the blockchain network. Ethereum contracts are written by using the Ethereum Virtual Machine (EVM) code that is a low-level, stack-based bytecode language. The instructions of this language are often translated into a human readable form that is referred to as **opcode** (see [19] for a complete list of EVM bytecodes). High-level programming languages are also available to define smart contracts. These can be compiled into EVM bytecode and executed in the blockchain. One of the most prominent language to define smart contracts is **Solidity**. The Ethereum platform is also used for implementing the Ether cryptocurrency. This can be exchanged between accounts. A wallet keeps a couple of public/private keys (that is the address). These are used to get and spend Ether.

The Ethereum blockchain forms a increasing list of blocks. Figure 1 shows all data that are contained in a block. A State of Ethereum is defined as a Merkle

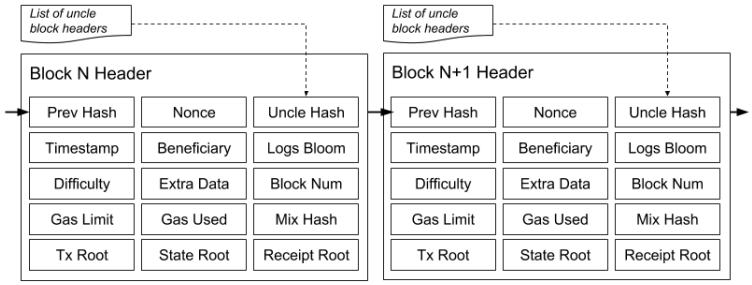

Fig. 1. Block data of the Ethereum blockchain

tree [8] and describes all current account balances and some additional data. The *state root* field is the hash of the root node of the state tree after all transactions are executed and finalised. The *tx root* field is the root of the Merkle tree which has all validated transactions. A transaction can be related to the transfer of Ether, the definition of a smart contract, the running of a smart contract or a token management. The *timestamp* and *Block num* are the block addition time and its a unique block identifier, respectively. The state after the transaction execution is kept in a transaction receipt store. All receipts are stored inside an index-keyed trie [14]. The hash of its root is placed in the block header as the *receipt root*.

The bloom filter [3] is created by using transaction log information. This is reduced to 256 bytes hash and all hashes are in the block header as the *logs bloom*. Each block also includes the hash of the prior block in the blockchain, *prev hash*, linking the two. This ensures the integrity of the previous block, all the way down to the first block. The hash is calculated on the header fields by using the Ethash [19] algorithm. More precisely, every time a new hash block is calculated, the Ethereum nodes perform a mining process (also referred to as proof-of-work) where they must find a nonce value that produces a desired hash[1]. When a node find the nonce (i.e., the block is solved), the consensus is used to spread the solution to other nodes. These verify the solution proposed and add the block to the blockchain. Sometimes separate blocks can be produced concurrently. This creates a temporary fork of branches. The Ghost protocol [17] is used in order to select one of the branches leaving the others as orphan ones (the orphan branches are stored in the *uncle hash* field). All Ethereum transactions cost a certain amount of **gas** [17], which corresponds to a tiny fee required by the blockchain infrastructure to process the transaction. The *gas limit* is the maximum amount of units of gas a user is willing to spend on a transaction. The block gas limit sets an upper limit to the *gas used* block field. This is the sum of all gas spent by the transactions of the block.

[1] This is a hash that contains a certain amount of initial zeros. The number of zeros, defined by the *difficulty* field, establishes the computational effort that is needed to find the hash.

3 Smart lock application requirements

Figure 2 shows all entities that are involved in our smart lock system. Citizens can rent ebikes that are deployed in a smart city. Each ebike is equipped with a smart lock that can be opened and closed for renting purposes by using a mobile device. A service provider manages the user subscriptions and user rental authorisations while an insurance company provides liability, comprehensive, and collision coverage. Finally, companies such as data analysis ones can make use of publicly available data in order to perform analysis whose results are fed back into the society. The main functional and non-functional requirements of the smart lock system can be described as follows:

(R1) only users that are registered at the service provider can lock/unlock ebikes;
(R2) a user is charged per hourly use by using transparent contractual terms;
(R3) the profit is shared between the insurance and the service provider by using transparent contractual terms that cannot be changed unless they agree to do so;
(R4) rental contract and user data are stored in a trusted location and can be accessed at any time;
(R5) the lock and user device software should be suitable to run in a small embedded device that is constrained in terms of memory and CPU processing power (e.g., arduino [1]);
(R6) users privacy should be ensured (i.e., it should not be possible to understand which ebike is rent by which user);
(R7) the lock/unlock operations should take few seconds.

The first version of the smart lock application would store all lock and unlock user requests at the service provider. This would compute the user rental time at the end of each month in order to charge the user and pay the insurance fees. This solution was considered inappropriate by the insurance since they lack of mutual trust thus requirement R4 would be violated. As we are going to see in the next section a blockchain-based solution was implemented in order to ensure data immutability and avoid the need of a third trusted part.

4 A blockchain-based smart lock system

Figure 2 shows the smart lock protocol at a glance in the case the lock is open. For the sake of simplicity the protocol is not described by using a formal cryptographic notation (e.g., protocol narrations) and the focus is on the open/close rental operations (although any other operation is possible). We assume that all messages are confidential, messages are authenticated and timeliness is ensured. To this ending, encryption keys, timestamps and nonces are used. We use the notation || in order to denote the concatenation of data.

Figure 2 does not include the initial setup where the insurance and the service provider define and store a smart contract inside the Ethereum blockchain. This defines the hourly cost of the ebike renting, the insurance and service provider

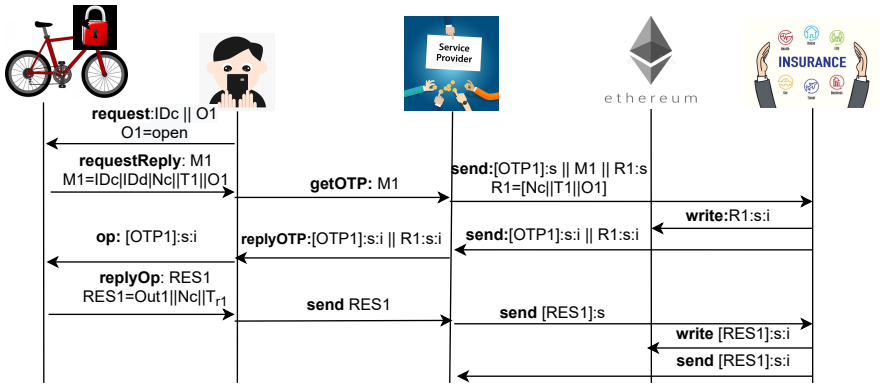

Fig. 2. Smart protocol opening scenario.

profit share, and all rental data that will be exposed. A user needs to register on the service provider website in order to use the rental service. At any time the user can use the rental contract from the Ethereum blockchain in order to view its terms, its fees, check his payment history, his rental data and other useful information.

An ebike rental always starts when the user sends his identity and an *open* operation to an ebike lock (message REQUEST:$ID_c||O_1$ of Figure 2). The lock replies with a message M_1 that contains the identities of the device and the lock, a nonce N_c that uniquely identifies the user-device session and the time T_1 at which the operation was requested. The message M_1 is used by the user in order to interact with the service provider and get a one-time password (OTP) that is a password valid for one operation. A user can obtain the OTP by sending a request GETOTP:M_1 to the service provider. This receives the request and verifies the user subscription data and his balance. When the user is allowed to perform the operation a receipt $R_1 = [N_c||T_1||O_1]$ is generated and signed cooperatively by the service provider and the insurance company. This contains the operation OPEN that was granted to the user, the time T_1 at which the operation was requested and the user-device session identifier N_c. The signature is denoted with a colon followed by the signer. For instance in Figure 2 $R_1 : s : i$ denotes the receipt R_1 signed by S and R. The signed receipt $R_1 : s : i$ is written on the Ethereum blockchain by the insurance company which also returns it to the service provider. The service provider and the insurance also generate and sign a one time password (i.e., $OTP_1 : s : i$ in Figure 2). This is sent back to the user together with the receipt R_1 (message REPLYOTP : $OTP_1 : s : i||R_1 : s : i$ of Figure 2). The OTP can be used to open the lock and the receipt R_1 can be kept locally by the user device for checking the fees to be paid or to solve any payment dispute that arises with the service provider.

The lock can now receive the OTP_1 and reply back to the user with the result of the operation (i.e., REPLYOP:RES_1 in Figure 2). The data RES_1 contains the result of the operation (i.e., error or ok), the user-device session (i.e., N_c) and

the time T_{r1} at with the result was generated. The result is always forwarded by the user to the service provider. The service provider and the Insurance cooperatively sign the result and write it on the blockchain. Error results are stored in the Ethereum blockchain in order to avoid the user is charged unfairly.

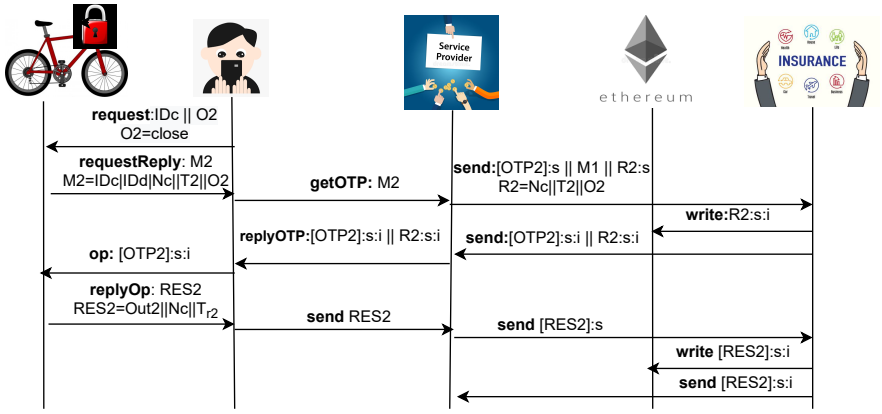

Fig. 3. Smart protocol closing scenario.

Figure 3 shows the closing scenario. The flow of the operations and their content are almost identical to the open operation. The only difference is the timestamp of the operation and the result (i.e., T_2 and T_{r2}), the generation of a new password (i.e., $OTP2$ in Figure 3) and a new result content.

4.1 User and insurance fees calculation

At the end of each month the service provider uses the smart contract and the public data in order to perform the following operations: (i) charge the users per hourly use; (ii) pay the insurance by considering the monthly bicycle rental time.

Suppose that a user session N_c is used to open the lock of a bicycle at time t_1 and the lock is closed at time t_2, then we denote with $t(N_c, t_1, t_2) = t_2 - t_1$ the time between a lock and an unlock operations (i.e., the time the bicycle was used). We denote with $T(u, a)$ the amount of hours the user u rents bicycles in a day a. This can be defined as $T(u, a) = \sum_i t(N_c, t_i, t_{i+1})$ where all t_i belongs to the same day a and N_c are all sessions of the user u in the day a. The user will be billed monthly by considering the monthly user bicycle rental time. This is calculated as follows: $T(u, m) = \sum_{a \in m} T(u, a)$ where u is the user and a is a day of the month m.

The service provider will pay the insurance company monthly by considering the monthly bicycle rental time. This can be calculated as follows $T(m) = \sum_{N_c \in m} t(N_c, t_i, t_{i+1})$ where N_c is a user session that is performed in the month

m. The payment is done by using the blockchain as established by the registered contract.

5 Discussion and results

Our smart lock system complies with all requirements that are described in Section 3. The one-time password OTP is only generated after a successful user authentication thus only authorised user can access the service (i.e., requirement $R1$). Ethereum ensures transparency and allows citizens to recompute the fees based on the public data and the public contract that are available at the blockchain. This ensures high integrity of the data stored (i.e., requirement $R2$). The profit is shared between the insurance and service provider by using an Ethereum smart contract. This defines the contractual terms in a transparent manner. Changes cannot be performed unless they agree to do so (i.e., requirement $R3$). The blockchain stores data in an immutable and secure way without the need of a central trusted authority (i.e., requirement $R4$). Our customised protocol allowed the implementation to run in small embedded devices that are constrained in terms of memory and CPU processing power. Our current implementation runs in an Arduino [1] like device where standard approach such TLS would not run (i.e., requirement $R5$). The public blockchain shows anonymous data that are the user random session identifier and the time of rental thus it is not possible to understand which ebike is rent by which user (i.e., requirement $R6$)

Our public blockchain-based implementation supports the data democratisation vision where everybody has access to data and there are no gatekeepers that make use of isolated data silos. To date data are used by third-party companies in order to calculate various statistics such as reduction in carbon emission and rental time. These statistics are fed back to the users in order to encourage a greener society.

OCM	**RDA**	**SAT**
10	634876	222607
20	1269688	416244
30	1904628	610379
40	2539952	803924
50	3206367	998992
60	3809896	1193854
70	4444836	1388638
80	5079584	1584176
90	5714780	1780853
100	6349208	1976492

Fig. 4. Gas consumption for the lock case study

We have simulated the smart lock protocol in order to calculate the fees that must be paid to write the user operations (i.e., open and close) on the public Ethereum Blockckain. We have used a scenario where each smart lock sends messages related to its opening and closing to a BESU Ethereum-based blockchain. A process generates 10 artificially generated datasets. The first dataset contains data for 10 opening and 10 closing messages in a month. Each subsequent dataset contains ten opening and closing operations more. The last dataset (the tenth) contains 100 opening and closing messages.

The insurance write the transaction on the blockchain according to the following two different strategies:

(RDA) this simulation is complaint with the protocol that is described in Section 4. Each opening and closing message is written by using a separate Ethereum transaction;

(SAT) this simulation stores at the end of each month all opening and closing operations in a single transaction.

Figure 4 shows our simulation results. We denote with *OCM* the amount opening operations in a month. For both RDA and SAT scenarions the gas consumption has a linear growth with respect to the number of OCM. The SAT approach saves around 64% gas consumption when compared with the RDA one. In fact, while the RDA solution writes an Ethereum transaction for each opening/close, the SAT solution only store an Ethereum transaction at end of each each month (this has all opening and closing transactions). At the time of writing this paper, the RDA based solution for 100 opening and 100 closing operations would have a GAS consumption of 6349208 that is 1.7650798 ETH (about 2.524 euro). The SAT based solution would have a GAS consumption of 1976492 that is 0.5494648 ETH (about 785 euro). This account for 3.9 euro per operation. When off-chain approaches (see [5] for details) are considered, GAS consumption decreases to 23952 that is 0.0066587 (about 9.5 euro). This account for 0.04 euro per operations. The time that is need for the operations is acceptable since it always takes few seconds. In fact, our protocol is not bound to the transaction speed of the Ethereum main chain. The receipt is returned to the user by the service provider without waiting the Ethereum mining process (see Section 4 for details).

6 Related work

Japan, where the Society 5.0 concept was born, represented some of the earliest adopter of Blockchain technology. Back in 2016, Japan's Ministry of Economy (METI) published a report about the impact of Blockchain technology with policy recommendations: the Japanese government followed this statement and we have seen numerous initiatives, as for example developing clear and fair laws to regulate cryptocurrency exchanges, or legally clarifying that Bitcoin is now considered an asset and a payment method.

At the beginning of 2018 Japan's biggest energy firm, TEPCO, invested in a British Blockchain startup. Other companies like SBI, Rakuten, Nomura and Daiwa are just a few of the brokerages spearheading the venture into new cutting-edge technologies like the Blockchain. Additionally, SBI launched its Ripple blockchain-based payments app for consumers. Is easy to see both the tech-savvy population and the government engaging in and encouraging Blockchain technology in Japan, again putting the country at the forefront of international technological development.

Sixteen Japanese virtual currency exchanges registered with the Financial Services Agency (FSA) joined forces in April 2018 to establish the Japan Virtual Currency Exchange Association.

Launched in 2018, the Virtual Currency Governance Task Force (VCGAF) is a study group established to develop safety measures for consumer protection. As they say "virtual currency perception has increased rapidly so in order to avoid large incidents consumer protection is an urgent task".

In May 2016, METI released a report on Blockchain technology, providing an overview of the technology, from detailing the step-by-step workings of a bitcoin transaction to outlining how the mechanics of the protocol could create stresses if applied to existing business practices. Use cases cited in the report included asset management, authentication, commercial distribution management, communication, content, crowdfunding, finance, IoT, loyalty points and rewards, medical services, prediction markets, public elections, sharing and storage.

Some cases of the Japanese government using Blockchain technology are: (i) Ministries of Justice and Land's Blockchain-based central repository of land and property registration; (ii) METI's Blockchain-based platform for trade; (iii) Japanese city of Tsukuba voting system using Blockchain.

Finally, METI also published "Japan's FinTech Vision", a comprehensive range of policy initiatives to nurture innovative FinTech services and create a dynamic market environment aimed at attracting entrepreneurs and companies from around the world.

In 2017, Tokio Marine and Nichido Fire Insurance and NTT DATA Corporation completed testing the first Blockchain-based insurance policy for marine cargo insurance certificates. Tokio Marine created a "data" bill of lading, letter of credit and a commercial invoice on a Blockchain, and tested this from the perspective of a shipper that needs a certificate of insurance in order to satisfy the insurance requirement on the letter of credit.

Organic Farm Aya, in Miyazaki Prefecture, together with Information Services International-Dentsu (ISID) and Sivira, worked on a pioneering blockchain pilot that will see organic vegetables grown in the prefecture logged on a distributed ledger. The system allows all parties to ensure the quality of organic produce from field to table. The pilot scheme also involves an Italian restaurant in Tokyo, which will begin sourcing its ingredients from farmers via the new platform.

Fujitsu launched "Blockchain Asset Service," and leverages user transaction data to promote regional revitalization. The Blockchain-based data storage sys-

tem tokenizes traditional retail promotional strategies such as coupons and loyalty points, which the company claims will revitalize local economies by increasing consumers' willingness to buy, as well as improving data analysis methods in retail industries. With this service, users can collect digital points or stamps reading QR codes located in specific areas with smart devices, and then exchange them for coupons and other benefits that can be used in stores and shopping centers within the specified area. In addition, collection and usage data for the points, stamps, and coupons, which are recorded on the Blockchain distributed ledger, can be linked with user information for analysis.

7 Conclusions and future work

This paper presents a novel secure protocol which integrates users, blockchain, two or more contractors and IoT devices that are constrained in terms of CPU and memory. The protocol allows authorised users to perform operations on the IoT devices. Operations are securely logged on the public blockchain which provides immutability and allows the execution of smart contracts. We have applied our protocol to an ebike rental system that combines IoT devices (i.e., smart locks), companies (i.e., service provider and insurance) and the Ethereum blockchain. Our novel blockchain-based protocol is used to securely control the open and close operations of smart locks, bill the users and share the profit between service provider and insurance. The protocol runs on small embedded devices, reduces blockchain fees and has a good performance in terms of operation response time. In fact, the secure protocol is not bound to the Ethereum transaction validation time which would take around 20 seconds to complete. The use of the blockchain avoids data monopoly. Smart contracts are public and can be used to make the users aware of the economical terms and the information they are exposing. Blockchain also solves the need of a trusted party between service provider and insurance that is needed to store the user rental data and share the profit. Public blockchain data are used by specialised data analysis companies to inject back into the society useful information such as fuel saved, reduced carbon emission and other customised information. Our protocol only exposes a random number and the rental time. Thus, it is not possible to understand which ebike is rent by which user. As future work we are planning to apply the protocol to other application scenarios.

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Modelling Transformation of Corporate Communications in the Digital Age

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Abstract. This article provides a brief overview on transformative trends in corporate communications based on a literature review. Furthermore, it presents a framework model on how to transform corporate communications in the digital age. The model is based on a grounded theory approach derived in a field study completed in 2015, which claims that more heterarchical structures in corporate communications are needed. In a subsequent project, the model is tested in an ongoing exploratory study. Based on the learnings from the two studies, we suggest a new model on how to organize corporate communications in the digital age. At the centre of the new model are written and audio-visual content, created by associates in a collaborative process and supported by the organisation.

Keywords. corporate communications, digital transformation, heterarchical structures, exploratory study, field study

1 Introduction

Back in 2005, in a book on corporate communications Göldi claimed along with others [e.g. 1] that the field of corporate communications does not exclusively belong to communications experts, but to every single associate within the company. Through their behavior (e.g. customer contact, negotiations with suppliers, their appearance in public) associates contribute to (informal) corporate communications and represent their company due to the "constitutive capacity of communication" [1]. However, in contemporary theories of corporate communications, as well as in practice, communication is still seen as a managerial task. Since corporate communications

reflects corporate policy, identity, reputation and image, it is mainly left to management and experts and not to employees in general for fear of "fragmentation" as opposed to an "orchestrated" or integrated communication approach [e.g. 2-6].

However, the integrated, unitary approach may no longer be as feasible as many would like it to be. In their review of perspectives on corporate communications, Christensen and Cornelissen [7] identify two different mindsets in corporate communications research and practice. On the one hand, a mindset that promotes the integrated approach, i.e., managing "all communication under one banner", which involves addressing different audiences at once with mainly one-way communication. On the other side of the equation lies a more participatory mindset that sees corporate communications as a more fragmented set of less uniform identities. They attribute this radical difference in perspectives to a "metonymic compression" [7]: "Communication" in corporate communications stands for a unitary actor while, in fact, by its very nature it also applies to many actors engaging in diverse communication activities. In any case, to date it does not seem that research in corporate communications has been able to resolve the discussion on whether, or when and why, corporate communications should be a centralized or decentralized business function.

Nevertheless, in practice, individual employees are still expected to align themselves with a unified corporate image or brand when communicating as members of an organization. The rise of digital channels poses a clear threat to this mindset and, thus, might finally change this. With the increasing pace of communication and need to be present and interact on digital channels, the one-person-speaks-for-the-firm-policy may eventually become obsolete. Social media, for example, which allow companies to have two-way conversations with individuals rather than with an abstract "audience" or stakeholder group, reduces the control companies have on messaging and agenda-setting as well as the public's interpretation of their messages. Employees sharing information on social media, either professionally or privately, are influencing corporate image although they might not always be aware of it [8], thus necessitating social media guidelines or policies to prevent unfavorable interpretations or fragmented messaging. These may be counterproductive. By its very nature, communication on social media channels should be authentic, transparent, immediate, collaborative, and it should represent the exact opposite of "centralized authority" [9-11]. In a similar way, communication on social media has also been described as "democratic" [e.g. 12]. Therefore, if the medium shapes the message, then the medium an organization chooses to communicate on may even be more important for corporate image and reputation than the message itself. However, many organizations continue to perceive these channels primarily as an additional venue to disseminate their one-way messages and are quasi-paralyzed for example when individual readers leave comments, thus turning it into a two-way communication.

Kaak [13] suggests that "new technologies may encourage new forms of communication" as technological advances have created new opportunities to communicate with stakeholders on an increased number of public-facing channels. As a consequence, the communications team alone cannot generate content effectively anymore which means that companies need new content generation workflows.

With more channels, new media and digital platforms, we expect that new digital

opportunities in corporate communications will create an ever-increasing demand of communication content and dialogue. In order to produce more content, especially more authentic content, and interact fast on multiple channels, companies need to develop new concepts for producing, managing and publishing communication content. Implementing these new concepts will require new structures in the organization as a whole as well as new roles and processes for its communicators and content managers. These changes go along with digital transformation encompassing economic, social as well as political elements determined by new technology and reshaping business structures, roles and processes [14]. Up to now corporate communications remains "a neglected perspective in discussions on the digital transformation" [15]. Digital transformation might partly drive changes in corporate communication or be driven by the transformation of traditional corporate communications management [16].

This article provides a brief overview on transformative trends in corporate communications based on a literature review and the authors' experience with digital trends in Swiss SMEs as well as international companies (section 2). Furthermore, it presents a framework model on how to transform corporate communications in the digital age. The model is based on a grounded theory approach derived from a field study completed in 2015 by Göldi and Waldau [17] claiming that more heterarchical structures in corporate communications are needed (section 3). In a subsequent project, the model is tested and refined in an ongoing exploratory study that is briefly described (section 4). Based on the learnings from the two studies, we suggest in the conclusions a new model on how to organize corporate communications in the digital age (section 5).

2 Transformative Trends in Corporate Communications

One option to cope with the increased demand for content with limited resources is by streamlining content distribution. For example, a number of low-cost applications allow social media managers to curate content in multiple accounts and channels simultaneously. Single-source, multi-channel content management systems represent solutions with a more sophisticated set-up consisting of a repository of content. They enable content repurposing for multiple channels and audiences. Associated with the "create once, publish everywhere" approach (COPE), these solutions require that content is broken down into smaller semantic units which are tagged and stored in the repository, allowing the content manager to retrieve and combine content modules to produce a new whole.

Apart from saving resources which could be put to better use for content creation, a possible reason for the quick adoption of these solutions could be that, to a certain extent, they guarantee consistency in customer or user experience across channels. However, while representing a cost-effective way of repurposing and distributing content to digital channels, this approach often still requires editorial involvement for content to resonate with different audiences and contexts. Repurposing content may also result in a loss of authenticity.

Another option may be to change planning processes. A predominantly linear

workflow, in which an approval process is instigated once content is created, could be transformed towards an iterative and situation-oriented collaborative approach [13], in which responsibility for creating and approving content is shared as required by the nature, topic or audience of content. However, managing alternating workflow as well as mapping it in a system can be difficult, which may at least partly explain the reluctance in adopting this approach. However, a trend towards less linear workflow may be emerging. As Klewes, Popp and Rost-Hein [18] predict, "communicators will become curators of networks in which content takes shape in a more or less chaotic form". They observe three organizational trends within digital transformation in corporate communications:

- more creativity through breaking traditional systems and rules
- a new form of employment identity that is coined by constant change and a "liquid" workforce
- more connection through platforms that enhance collaboration and facilitate new production communities.

These communities are not limited to the workforce. Empowering customer groups or jointly producing content with customers is another content strategy that breaks with traditional approaches due to increased digital range. Described as customers assuming a new role of content co-creators and innovation drivers, Rumpold-Preining [19] concludes that more expertise in co-creation is needed in communication teams as it generates more customer focus. For example, incorporating customer feedback into a content strategy enables a data-driven and personalized approach towards content creation.

Among others, Kaak [13] and Shin, Picken and Dess [20] ascribe to empowering principles that lead, for example, to self-organization as well as to employees who take responsibility for their actions. In other words, instead of building structures to plan and control corporate communications, a company needs to empower its employees to communicate. This also involves structural empowerment, which ranks as a sufficient condition for innovation in many organizations [21] and as a necessary condition to empower individual employees [22].

There is extensive literature on empowerment. Nevertheless, Lee and Edmondson [23], for example, who review the literature on less hierarchical organizations and identify research categories, conclude that the scholarly understanding of decentralized authority remains limited. They also state that managerial hierarchy does not only persist because of a gap between 'a belief in its effectiveness and its actual effectiveness', but also because there are no well-known alternatives [23]. In the past decade, several companies have explored new ways of organizing themselves and have adopted less hierarchical structures as a result. For example, the online retailer *Zappo*s adopted holacracy, an organizational system based on the principle of self-management [24]. Another example is the tomato processing company *Morning Star* that fosters a radical form of decentralization where employees enter bilateral contracts with their colleagues [25]. A third example is the computer game producer *Valve* that allows employees to choose which project they want to work on and, moreover, where the employee handbook explains that no one reports to anyone [26]. In Switzerland, *Swisscom*, the largest telecom services provider, started experimenting with holacracy;

the internationally active textile producer *Freitag* changed its organizational structure to holacracy as well as the software developer *Liip*.

Clearly, empowerment is as closely connected to a change in structures, roles and processes as digital transformation itself. Managerial hierarchy works well as long as conditions are stable and tasks are well known. As soon as dynamic and novel situations arise, such as the challenges posed by new technologies, managerial hierarchy faces its limitations, ranging from the inhibition of "solving complex non-routine problems" to rigidity [23]. Attempts to avoid these consequences often finally lead to "numerous and varied efforts to organize less hierarchically" [23]. Huq's *Model A* [22] shows that core elements of empowerment such as power-sharing, participative decision-making, devolution of responsibility and people-oriented leadership style change traditional roles and accelerate processes. Spreitzer [27] claims that there are mainly two kinds of empowerment: structural and psychological empowerment. Whereas the former focuses on empowering structures, policies and practices, the latter focuses on "perceptions of empowerment" [27]. Structural and psychological aspects also seem closely linked as the responsibility for changing structures and roles lies with a company's leadership. However, top-level leaders and chief executives often feel threatened by the idea of empowering employees since they fear the loss of control and their own power. They have to be willing to let go of some of their responsibility and control in order to empower their employees and to allow space for action. Wilson [cited in 22] points out that finding a balance "between a democratic and an authoritative approach" is one of the main challenges for leaders. This means that leaders have to take on a new identity and shift their tasks towards enabling, encouraging and supporting employees. In order to empower employees, new approaches in corporate culture are also required, especially in dealing with failures and critical thinking. Otherwise, employees might want to avoid the consequences of making a wrong decision within a participative decision-making framework and therefore refrain from adopting a leading part in corporate communications.

3 Conception and Reflection of the Transformation Framework

In a field study, Göldi and Waldau [17] embarked on firstly, modelling, and, secondly, explaining the passive behavior of employees after collaborative platforms, equipped with the same functionalities as social media platforms, were introduced to their organization. Because a main premise of their study was that fundamental team transformation processes were required before the benefits of these platforms, such as knowledge transfer or peer learning, can be harvested by organizations, they decided to model and measure success of these processes within teams. However, finding an appropriate model turned out to be difficult, especially since most transformation models do not focus on employees and their actions. As Göldi and Waldau discuss [17], there are mainly two models that describe a change towards web-based communication: the DOI-model (Diffusion of Innovation) and the TOE model (Technology-Organization-Environment). Whereas the individual does not play a great role in the TOE, the more comprehensive DOI theory includes the individual attitudes of

managers towards innovation. With distinction of the tow concepts of innovation and diffusion, the DOI theory contributes significantly to the differentiation of processes. However, neither model is suitable, in the context of communication and empowerment as they barely involve actors and actions.

3.1 Starting with the Actor-Type Model

Thus, the authors reverted to Dolata and Schrape's [28] actor-type model, which specifically categorizes user groups according to the purpose of their actions. The field study's main research question was to discover how approximately 300 employees and other stakeholder groups working directly or indirectly in corporate communications could be motivated to use a newly provided digital communication platform, which allows them to retrieve information, collaborate and share experience.

However, the Dolata & Schrape [28] model required extending for it to be able to map the transformational processes at play in this particular organization. **Fig. 1** shows Göldi and Waldau's [17] application (red square) and extension (green square) of Dolata and Schrape's [28] actor type model. Dolata and Schrape's model originally juxtaposes two categories of action types in a virtual room: "individual actions" (by individuals or individuals in swarms) and "collective actions" (by communities or organizations).

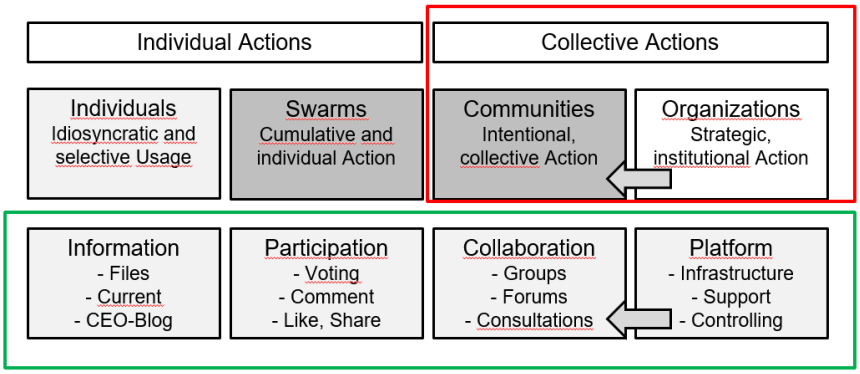

Fig. 1. Göldi and Waldau's [13] extension of Dolata and Schrape's [14] model

Categorized along the original types of individual and collective actions, the model was first extended by the four areas of "information", "participation", "collaboration" and "platform" (**Fig. 1**, green square) in order to represent the four areas of action given by the new tool to enable digital corporate communication. Secondly, the model was revised by reading it from right to left (**Fig. 1**, red square), starting with "collective actions" and leading to "individual actions". This reversion makes sense in a conceptual

(opposed to an analytical) scenario, when trying to fuel action and provide structure for digital corporate communications. In this application the corporate actor plays the role of enabler, providing resources and shaping infrastructure according to strategic goals. In this new setting—which likely represents many corporate communications settings—user manuals, news and a CEO blog were provided to allow employees to retrieve useful information from the platform. Furthermore, participation options (as a swarm) such as votes, comment sections, "like" and "share" options within the news stream and the CEO blog were introduced. Finally, tools for collaboration as a community and sharing were developed and tested such as groups, forums and consultations.

3.2 Building a Transformation Framework

Based on the results of field study, a framework was developed with the goal to describe the main factors affecting transformation of corporate communications in the age of digital media (**Fig. 2**).

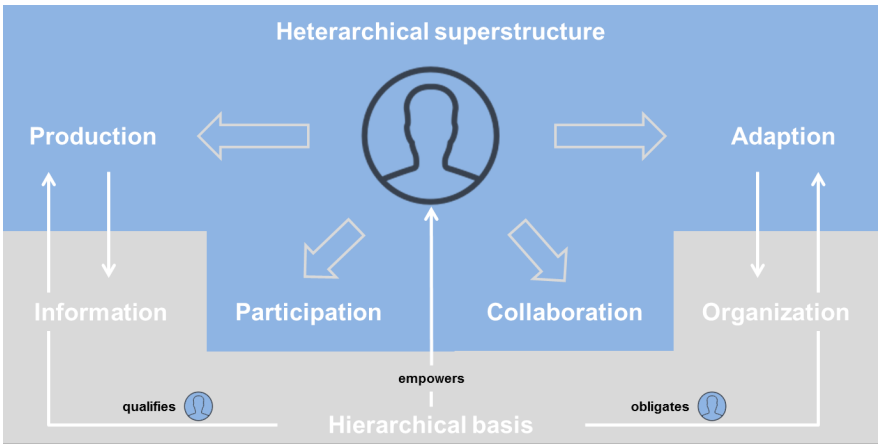

Fig. 2. Transformation framework for digitalized corporate communications

Consistent with the literature reviewed above, the model in **Fig. 2** starts with the idea of employee empowerment (center), then it models transformation from a traditionally hierarchical organization towards a hybrid organization combining hierarchical and heterarchical structures. It is therefore not radical in its aim but builds on and maintains hierarchical structures. The hierarchical basis (grey area in **Fig. 2**) provides structure such as a digital platform and designs processes to qualify and obligate employees in their roles as corporate communicators. Furthermore, the hierarchical basis is accountable for information (left grey area) and organization (right grey area) regarding the transformation itself. As a result, the basically hierarchical organization aims at

maintaining a heterarchical superstructure that empowers, qualifies and obligates employees to participate in corporate communications, to produce content for different channels and to collaborate through adoption of newly provided digital tools.

3.3 Main Driving Forces of Transformation in Digitalized Corporate Communications

In order to enhance a) production of communication content, b) adoption of a provided platform and c) participation in votes and comment sections, etc. and d) collaboration in groups and forums, the following three driving forces were defined within the transformation framework model: *empowerment*, *qualification* and *obligation*.

Empowerment. The company needs to empower employees to be content providers in the sense of allowing them not only to produce communication content, but also to edit and publish it. Too much control between writing and publishing acts as a showstopper. It slows down processes and counteracts the dynamics of social media. Furthermore, controlling communicates mistrust and the idea that there is right and wrong. Both effects prevent the flow of content to social media. Therefore, empowerment is crucial in the involvement of employees in corporate social media.

Qualification. Connected to empowerment is the need to qualify employees to fulfil semi-professional standards in corporate communications. At the same time, the organization needs to adjust standards to an adequate semi-professional level that corresponds to the skills employees either already have (e.g. writing skills) or can be evolved. In fact, companies face two choices: either to lower standards or heighten the investment in measures to qualify employees to contribute to digital media need.

Obligation. We assume that obligation must go hand in hand with qualification and empowerment not only to enable but also to motivate employees to learn new skills and to take on new tasks and responsibilities. In retrospect, after testing the model in different corporate cultures, this third driving force is called into question since obligation, on the one hand, and empowerment and qualification, on the other hand, apparently are at odds with each other.

The following section will further discuss the aspect of hierarchical basis and heterarchical superstructure in order to allow empowerment.

3.4 Hierarchical and Heterarchical Orientation in Corporate Communications or How to Empower Employees in Corporate Communications

The main lesson learnt from the above project and main reason to develop a new model (**Fig. 2**) was the fact that eliciting participation and collaboration pose more of a problem for organizations than distributing content or information. Information in corporate communications flows traditionally top-down: Leaders set the agenda for an information channel, content is produced and spread by corporate communications managers who have sole control over what is published on it. Therefore, hierarchical

structures harmonize with a mainly top-down and "one-to-many" communication orientation regarding the information flow. Participation and collaboration, on the other hand, require heterarchic structures because collaboration, sharing and dialogue ("many-to-many") require dynamic agenda setting, freedom of writing and freedom of editing and publishing.

Social Media Require Organizational Transformation. Social media work in a very different way—not only regarding pace and style—but also in regard to the number of contributors. To exploit the potential of social media, a company has to ensure that it is used by more than only a few contributors. The more contributors and the more diverse these contributors are, the higher the likelihood that more valuable content is created. Furthermore, social media per definition serve as a way to exchange written and audio-visual messages and connect their contributors and users in a social network that resembles more a community held together by common interests and by individual expertise than by social structure.

Qualification and Obligation. Organizations that want to qualify a major part of the workforce (maybe even all employees) to be able to contribute to corporate communications are challenged in two ways. The first challenge is to provide writing skills including editing and publishing skills; the second challenge is the adaption of new roles with more responsibilities. This second challenge addresses psychological aspects of digital transformation.

If a company can rely on an academically advanced workforce, qualification efforts are more limited. Detailed guidelines (online and offline), adequate coaching as well as a reliable and patient support are needed so that academically educated employees can meet the journalistic and media-appropriate editorial expectations. Depending on the basic skills of the individual employee, a certain amount of training by the organization will be necessary. If, however, a major part of the employees lacks advanced or even basic writing skills, the challenge is huge. One way to deal with it would be to appeal to the workforce to seek higher qualification in the formal educational system in form of an additional tertiary degree. Another option would be to establish large training programs or implement other intensive measures to qualify employees. No matter which options a company chooses, there is one major restriction: To force employees to learn new skills and to take on more responsibilities is not a good option as it is neither effective nor efficient.

In addition to providing someone with the necessary technical and journalistic skills, it will also be necessary to sensitize the employee to the needs of online communication by discussing topics, such as:

- reacting to comments (both positive and negative)
- copyright law when, for example, using sources
- working with pictures and video material with due respect to data protection laws.

The above items are only a few of the most important requirements of a semi-

professional use of corporate social media. In the following, we present the learnings form a follow-up exploratory study.

4 Learnings from a Follow-up Exploratory Study

4.1 Concept of the Exploratory Study

In order to learn more about how to set up digital corporate communications based on the transformation framework (**Fig. 2**), we designed a concept for a collaborative blog, a common corporate communications tool. In this blog, around thirty members of an institute at a university of applied sciences publish didactical solutions to overcome the so-called "post-meal coma", sometimes also referred to as "food coma" or "graveyard-slot" during conferences. The German term for it translates as "soup-coma". The soup-coma refers to the attention deficit after a lunch break; when students are digesting food, they often feel a bit tired and dazed. This, of course, is unfortunate for a study program that depends on students' attention. Therefore, lecturers tend to include short interludes in their programs to quickly restore their students' attention after such a break. The blog aims at collecting these interludes to share solutions for a commonplace problem and to attract public attention, to draw parallels to certain study programs and ultimately to attract new students. These motivations are also typical in corporate communications.

To do this in an adequate form and as a contribution to corporate communications, the concept includes specific requirements regarding the formal aspects of contributions [29]. These requirements mainly comprise three aspects: the contribution consists of a) structured text, b) audio-visual content and c) metadata (e.g. picture description) and links to other content on the institutional website or the internet.

Data is collected through observation and interviews with contributors in different roles. In an action-research-scenario, learnings are applied and settings are adapted to keep the blog and study up and running.

4.2 Learnings

Unsurprisingly, infrastructure is the easy part. We set up a WordPress blog, a YouTube channel and used Cognito forms to create a template for the blogpost. The form is a major balancing act between obligation (elements that are compulsory) and empowerment (permission to free expression). As a measure of qualification, we use explanatory remarks in the form to declare why certain information is required. The provided infrastructure includes supportive features such as guidelines, background information or contact information on how to reach first level support. Apart from support, costs are low after everything is set up.

The reviewing and publishing process and the corresponding roles undergo a major change in digitalized corporate communications. In a traditional corporate communications context, a professional in corporate communications (together with his or her supervisor) reviews a contribution and either accepts, re-works or rejects it. In larger firms with a professional corporate communications department, there might also be a copy-editing process to ensure correct spelling, adherence to corporate design

and corporate language. In smaller firms, however, reviewing and copy-editing are often combined in one role. The major change in a dynamical digital setting is that no supervisor is involved. This means that contributions will not be rejected and that peers review and publish communication content. Reservations against this major change concern quality and responsibility issues. In a heterarchical setting, responsibility for content as well as its form are handed over to the contributors and their peers who act as reviewers and publishers. It is the collective that moves to the centre of content production rather than an individual and specialized employee or team.

Review criteria are not subject to arbitrariness, but a set of communicated guidelines. At the same time, there is no compulsory obligation to adhere to guidelines. Moreover, guidelines are subject to modifications if the collective objects to certain rules or establishes better procedures. In other words, during the starting phase there is a predefined set of loose rules to guide everyone involved that can—and in a best-case scenario will—evolve.

The role of the content manager encompasses setting up and handling the infrastructure including supportive features. In addition, the content manager organizes the contributions (when) and roles (who, what) and offers support if needed. She or he collects all data for the blog post: structured text, pictures, audio-visual content, metadata, links. The content manager then takes care of technical handling of the content in the blog. As videos are involved, this includes feeding a YouTube channel and linking the blog to this channel. First, the blogpost is set up as a draft. Then the content manager notifies the reviewer/publisher as soon as the post is ready to be reviewed and subsequently published. The content manager acts as first-level supporter, especially concerning the production of audio-visual content. As the role of the content manager is centralized in one person (during a certain period), while production, review and publishing are ideally performed by many, the content manager causes most costs.

Finally, all roles are interchangeable, meaning that every producer of a contribution can switch his or her role to reviewer/publisher and vice versa or even become a content manager. This has several consequences. For example, employees experience the roles and the related liabilities from different perspectives (producing, reviewing, publishing, managing). Another consequence can and should be that employees share responsibility while collaborating in the best sense of the word pursuing the company's overall goals. Yet another consequence can be that employees learn from each other and that they build new skills, trust and social cohesion.

5 Conclusion

As a preliminary result, we present a corporate communications content model for a contemporary approach to corporate communications in the age of digitalization (**Fig. 3**). It focuses on content in the age of digitalization that needs to be shaped in a multimodal and online-adapted way. Content consists of written parts combined with audio-visual parts optimized with metadata and links. **Fig. 3** also shows processing members of staff in alternating roles of content producer, content manager and content

reviewer/publisher. The model claims that the main requirements—besides a collective with a shared goal, a working infrastructure and adaptable guidelines—are enough time and budget.

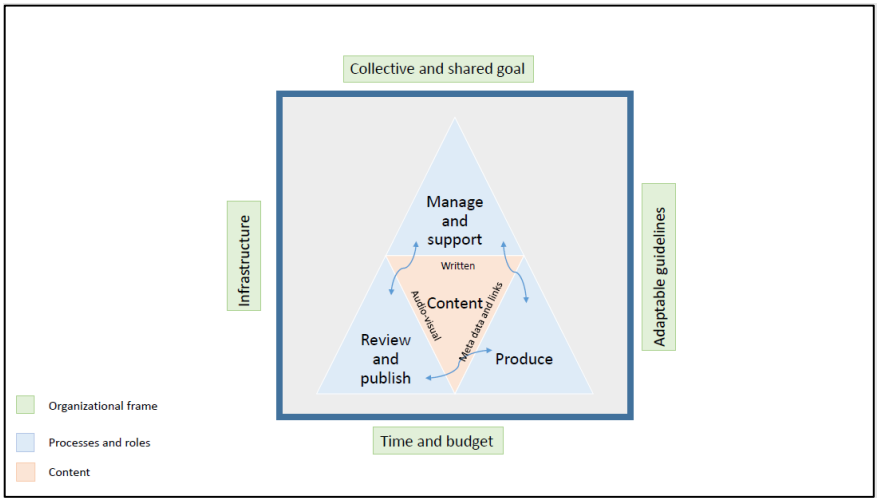

Fig. 3. Big picture of content management/corporate communications in the digital age

In this heterarchic approach, the organization empowers its employees by providing infrastructure, assigning tasks and roles to a collective and by qualifying them mainly through supportive infrastructure, learning by doing and learning from each other. In contrast to traditional organizations with hierarchical structures, the roles of content producer (writing and recording of audio-visual recordings), content manager as well as reviewers and publishers are not exercised by delegated communications specialists, but by everyone in the company. Finally, empowerment not only means to allow staff to produce, manage, review and publish communication content on corporate channels but also to value their work and effort. Therefore, budget to fund this empowerment is also crucial. If employees across an organization are empowered to communicate, the model may also help create more content. Thus, the increased demand for valuable and authentic content for larger audiences on multiple channels can be met.

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Implementing Robotic Process Automation for Auditing and Fraud Control

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Abstract. The cost of fraud continues to be a problem for many organizations in the global economy. This study explores how robotic process automation may offer a way forward for organizations to reduce fraud and advance organizational audit effectiveness for detecting potential fraud areas and cases.

The research was performed by conducting a literature review that considered 22 articles (through a selection process) on the relevant research themes of robotic process automation, fraud and auditing.

The findings suggest that organizations should consider robotic process automation as a means for reducing fraud opportunities in organizations. Robotic process automation may also assist organizations to advance their audit efficiency and effectiveness.

The paper conclude by proposing a theoretical framework for the implementation of robotic process automation in fraud control and auditing. A number of new theoretical questions arose during this analysis. This include, the potential use of robotic process automation by fraudsters in support of organizational fraud and secondly, the new skills required by auditors to be effective in an intelligent workplace.

Keywords: Robotic Process Automation, Fraud, Audit, Systematic Literature Review.

1 Introduction

The challenges posed by fraud are significant. The annual, global losses caused by occupational fraud exceeds seven billion US Dollars [1]. One form of occupational fraud, namely asset misappropriation, caused the collapse of various banks in Iran [3]. In general, occupational fraud is widely recognized as a contributing factor to banking crises across the globe [4]. Except for asset misappropriation, other forms of occupational fraud exist namely corruption and financial statement fraud [2].

The significance of fraud as an organisational problem, necessitates the need for an organizational audit function, involved in fraud detecting and control [5]. Organizations should take the necessary precautions to reduce the risk associated with occupational fraud.

One precaution that organizations may consider is the use of robotic process automation. Robotic process automation refers to software tools which automate the execution of tasks by using the same interface that a human actor would [6]. By reducing

repetitive human interaction with computer systems, robotic process automation aims to improve return on investment through automation and streamlined organizational business processes [6]. This is against the backdrop that the most common methods for concealing occupational fraud include the creation of fake physical documents, the creation of fake transactions and the altering of transactions in an accounting system [1]. Minimising interaction with computer systems could potentially decrease the risk of fraud. Robotic process automation may also be beneficial for the audit function by automating many audit tasks [7].

This convergence of technology and people into the same workspace to solve a global problem aligns with the goal of society 5.0 to integrate Industry 4.0 technology with human ideals [29]. Robotic process automation maintains the industrial focus expected from such technology [29] with the goal of addressing illegal, fraudulent activity [7], contributing to the economic advancement envisioned by society 5.0 [30].

The purpose of this systematic literature review is to explore, how robotic process automation may offer ways for organizations to reduce the risk of fraud and advance their audit effectiveness. The study is a generic study, not bound to a specific industry or geographical location.

2 Research Method

The section will briefly discuss the process that was performed during the systematic literature review to answer the following research question:

How can robotic process automation be used in organizations to reduce potential fraud and advance audit effectiveness?

2.1 Search Terms

The following search terms were used in relevant academic journal databases: “robotic process automation” AND (“fraud” OR “audit”)

2.2 Selection Criteria and Quality Assurance

Table 1 presents the selection criteria (what was included and excluded) for the literature review.

Table 1. Selection criteria for the literature review.

Inclusion criteria	Exclusion criteria
1. Peer-reviewed articles.	1. Non peer-reviewed articles.
2. Articles that focus on robotic process automation, auditing and fraud control.	2. Articles whose focus is not robotic process automation, auditing and fraud control.
3. Articles published in the last 3 years for the most current research.	3. Non English articles whose full-text is not available.

4. Relevant articles in any industry and geographic location. 5. Articles published in the last 3 years for the most current research.	4. Articles older than 3 years, for the most current research.

2.3 Source Selection and Data Extraction

The search terms were applied to the following database sources for the literature review: EBSCOhost, ScienceDirect and ProQuest.

The search results were filtered to only include academic works. The database search returned 135 articles. After duplicate articles were removed, 125 articles remained. Article title and abstracts were then screened for relevance and only 66 articles remained. The remaining full-text articles were assessed for appropriateness (using the inclusion and exclusion criteria) and 44 articles were excluded with reasons. Finally, a total of 22 articles were consulted during this literature review, which was carefully captured in Microsoft Excel.

3 Analysis and Discussion

During the systematic literature review, relevant literature themes emerged. These themes are: the automation of mundane tasks (19 relevant articles), process identification for robotic process automation (8 articles), data standardization (5articles), robotic process automation (RPA) vendors (5 articles), the changing role of the auditor (7 articles) and RPA threats (9 articles). A discussion of these literature themes follow.

3.1 Process Automation

The literature indicates that robotic process automation (RPA) is mostly used to automate and replace mundane audit tasks that allow employees and auditors to shift their focus to other organizational tasks [7-25].

Mundane audit tasks involve tasks such as audit evidence gathering [10,25,26], but RPA also saves employees time through automation that helps them to be highly efficient [26]. The time saved allowed employees to focus less on repetitive tasks and more on skill-intensive, value-adding activities such as the use of professional judgement to make decisions [10].

By automating tedious, manual processes, RPA allows auditors to expand the scope of organizational audits [25]. RPA software flag audit exceptions and errors which require expert intervention or further investigation [8,12,21,23,26]. The ability to quickly gather audit evidence across an entire population allows for continuous, real-time analyses of audit evidence [8,23,27].

The nature of RPA as a software solution which performs highly repetitive, predictable tasks also means that the process can be well documented and lead to increased audibility of automated tasks [21-23]. This means that RPA can be programmed to follow control requirements and therefore increase confidence in control tests [23] and compliance [9,18,20,22,24,29].

The literature, therefore, indicates that the role of RPA in auditing and fraud control is primarily to improve the efficiency and effectiveness of audit engagements and automating evidence gathering and analysis to allow for wider audit scope and therefore an increase the ability to detect fraudulent activity. RPA can allow for standardizing, documenting and speeding up of audit engagements and high-risk activities and can aid auditors in performing their duties.

Furthermore, RPA can be used outside of the audit function to standardise organizational controls and ensure adequate documentation and compliance with control requirements to reduce he opportunities for fraud to take place [27,29].

3.2 Process Identification for RPA

The literature analysed, indicates that there is no consensus on which activities should be automated by robotic process automation. However, there is a need to automate processes which are highly structured and repetitive in nature [7,10,13,15,17,19,22,25], although the specific functional areas or tasks are not specified [13].

In other words, structured audit tasks which are well defined are best suited to RPA automation techniques [22,25], such as substantive audit procedures [10]. Expert involvement is required to identify which processes can be automated and how to optimise the solution [15, 17]. Understanding how to automate the processes is equally as important as identifying the processes for robotic process automation [10,19].

An example from the literature is the use of robotic process automation to automate substantive procedures testing loan valuation, recording and disclosure [10]. Data was collected from source reports, prepared for loading into Microsoft Access and automatically execute the desired audit tests [10], where it was able to detect the expected anomalies faster than an auditor could [10].

Processes are identified for automation based on task data structure and repetitive, predictable workflow. RPA is sometimes classed as part of the wider intelligent process automation (IPA) environment [7,15,21,25]. This means that RPA could potentially be integrated with other intelligent automation tools such as tools that involves machine learning [22] to further enhance its effectiveness [25-26].

Also note that RPA automate existing processes rather than replacing them and may therefore automate existing control weaknesses and inadequacies [18]. While RPA does not necessitate process reengineering [24], it could perhaps be a driver of audit engagement and fraud control improvement to enable its use [19].

3.3 Data Standardization

RPA requires quality data to perform adequately [13]. When a robotic process automation solution is being considered, the format, source and compatibility of related data must be considered [7,15].

In the literature, there are two dimensions to data standardization. First, organizations that implement RPA need to consider cross-functional organizational data needs [20] and their related controls [13]. Furthermore, organizations which aim to reduce fraud using RPA should ensure that the data needed is of the correct level of detail,

quality and security [13]. Just as RPA can cause incorrect decision making if implemented with poorly designed process, poor data and data standards can lead to similar problems.

The second dimension for data standardization is audit data standards. In order for RPA software, when used by the audit function, to give consistent and reliable results, the data dictionary, labels and preparation methods for auditing should be defined and followed by the audit function [10,15].

To conclude, the successful use of RPA in organizations to address fraud and enhance audit interventions require strict data standardization and governance considerations.

3.4 RPA Vendors

In the literature, a number of articles refer to specific vendors for implementing RPA solutions [14,15,19,22,25]. Only one literature source mention the development of in-house RPA solutions [15].

In other words, in-house development for audit and fraud control RPA systems does not appear as widespread as vendor-provided solutions. It further appears that RPA solutions developed in-house may be used in conjunction with vendor purchased solutions to address fraud and audit control needs in an organization [15].

3.5 The Changing Role of the Auditor

As mentioned earlier, one of the roles of RPA in auditing and fraud control is the replacement of mundane tasks, allowing employees to focus on more challenging, value-adding tasks.

This implies that the role of auditors will change to better fit the new role demands that RPA offers. Data analytics is one area that is transformed when using RPA [25]. RPA allows for more data to be collected and processed than if similar processes had to be conducted manually [25]. Data can also be analyzed in conjunction with other artificial intelligence technologies [25]. Auditors will therefore need a good understanding of analytics and artificial intelligence techniques in order to achieve the best results from the use of RPA. This is aligned to the claim that accountants will be required to develop more technical skills for the RPA environment, such as data management [26]. The call for technical skills development in accounting students [23,26] indicates the need for professionals in this environment to embrace changing technological needs in the audit and accounting space.

The fact that RPA tools can flag suspicious transactions or records [8,12,21,23,26] for examination by experts means that a greater emphasis will be placed on professional judgement [8,10]. Auditors will need to be able to interpret flagged records adequately which may require fraud examination, analytical or forensic investigation perspective [8,23]. This perspective and professional expertise cannot be automated like the more structured, well-defined tasks which RPA targets [10]. The need for auditors will, therefore, not be significantly impacted by the use of RPA, especially considering the increased scope of audit engagements which RPA enables [25].

There is further no consensus on what the more challenging tasks undertaken by employees and auditors will be. The literature only indicates that analysis and more

challenging tasks (because of the automation of mundane tasks) will be a focus for auditors and that professional judgement and technical skills will be required. As more audit and accounting professionals develop their IT skills, in-house solutions could become more common. This points to a convergence of IT and audit principles and skills.

3.6 RPA Threats

RPA has implications with regards to governance, control and risk management in the organization.

Firstly, governance strategies of organizations will either need to incorporate RPA directly into existing governance frameworks, or create new separate decentralized RPA-specific governance structures to address the organizational changes brought about by RPA [13]. In either case, governance structures should be in place before any RPA implementation takes place [21].

Secondly, risk management strategies need to consider the effects of RPA [23]. Processes and process constraints may not be automated correctly in RPA software, which may lead to incorrect process results and unexpected process exceptions that carry risk [22]. Privacy and security concerns also affect the risk environment. Digital evidence gathering during auditing may potentially exposes sensitive data [15, 22]. In other words, there may be an increase in the risk of organizational cybersecurity breaches. These risk areas will require adjustments to the risk register of the organization and may lead to the modification of auditing standards [8].

Changes in governance and risk will further necessitate changes to the control environment. In order to address the security risks created by using RPA, controls will need to be implemented which aim to mitigate those risks. The organisation should implement controls which ensure the confidentiality, integrity, accessibility, accountability, authenticity and reliability of data used by the RPA software [24]. There should also be controls which address the possibility of faulty RPA workflow [12]. With these new controls in place, there will also be a need to audit the RPA system itself [12,23] to determine their adequacy and effectiveness.

Another problem posed using RPA in audit and fraud control is the use of RPA by fraudsters. Robotic process automation may be abused by its users to more easily commit fraud [16]. The relationship between RPA and fraud still needs to be thoroughly investigated [16].

However, implementation of RPA in the process of disclosing information constituting a banking secret to authorities was found to mitigate the risk non-compliance in areas such as protection of information and meeting statutory obligations [24]. Robotic process automation may therefore also provide a means to address some compliance threats by reducing errors in critical processes.

Organizations need to consider various applications of RPA and the effects on the organizational governance, risk and control environment to ensure strategic goals are met.

4 An RPA Implementation Framework in Audit and Fraud Control

From the systematic literature review analysis and discussion, seven pre-conditions were identified (derived from Section 3) when implementing RPA for fraud control and

auditing. A discussion of these pre-conditions follow, after which an implementation framework for RPA in auditing and fraud control is proposed.

4.1 Pre-Conditions for RPA in Auditing and Fraud Control

Seven pre-conditions (in no particular order) were identified for the successful implementation of RPA in fraud control and auditing. These pre-conditions may serve as a checklist that organizations may use for implementing RPA in fraud control and auditing.

Definition of Expected Outcomes: An organization should have a clear vision of the goals, objectives and role of a RPA implementation project. If there are clear goals, objective and roles defined for RPA in the target environment, appropriate decision of the correct processes can follow, assisting in successful implementation [10,19,22,25]. After implementation, the design can be evaluated against the defined goals, objectives and roles for RPA in the organization.

Structured Processes: A successful RPA implementation initiative requires that processes are already well structured and meet organizational goals [10,18,22,25]. Furthermore, processes targeted for RPA projects or engagements should already be well optimized and fit for purpose.

Involvement of Experts: The RPA solution should be implemented through collaboration with experts. This includes process experts who understand the process being automated, audit and fraud experts who can guide the project regarding control best practice, as well as information technology experts who can provide insight into the data and technical environment [8,10,15,17,19].

Data Standardisation: RPA requires structured data to perform adequately, therefore it is necessary to standardize data [22,25]. As consequence, if a RPA solution is implemented in a fraud control context, cross-functional data is available [20] which will be well understood and can be leveraged easily. If the RPA solution is being implemented in an audit context, then data standardization also refers to the audit data standards which should be in place to ensure consistent, easily interpreted results [10,15].

Evaluation of Threats: An evaluation of the threats which may occur in the target environment should be conducted. The changes which may occur in the governance, risk and control environment of the organisation as a result of a RPA solution being implemented [12,13,15,22,24] should be taken into consideration so that they can be responded to appropriately [21].

Solution Procurement: Organizations should decide whether a vendor RPA solution will be purchased, or an in-house solution will be developed, or a combination of both [15]. The type of solution which will be used may affect the time, cost, skill requirement and quality of the RPA project [14,15,19,22,25].

Skill Requirements: An organization need to determine whether or not it has the necessary skills to successfully implement a RPA solution. There will be a need for process, audit and IT experts [8,23,25,26], which may not be present in the organisation. If an in-house solution is required, there will be a need for RPA developer skills [15]. These skillsets are needed to successfully implement a RPA solution which meets the organisational goals.

4.2 An Implementation Framework

An implementation framework for RPA in auditing and fraud control is proposed that combine the identified literature themes of this study. The proposed framework involves the phases of *Process Identification* [7,10,13,15,17,19,22,25] , then *RPA Design and Construction* (and the technical skills involved) [23,26] and finally the *Results Evaluation* (or analytics) [25] presented by the software (see Fig. 1).

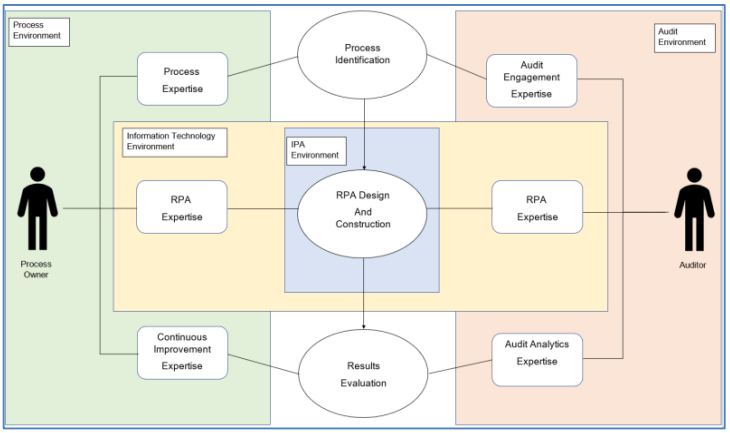

Fig. 1. An Implementation Framework for RPA in Auditing and Fraud Control

The RPA pre-conditions for auditing and fraud control (Section 4.1) may assist to prevent and detect fraud. These pre-conditions apply to both the audit environment and the existing process environment. In the audit environment, it is at least the auditor who will need to consider these pre-conditions and on the process environment, it is at least the process owner, as illustrated in the proposed implementation framework.

Process identification involves the identification of processes which are best suited for automation to meet organizational or audit engagement objectives. These are typically simple and structured tasks whose output is needed for later tasks [7,10,13,15,17,19,22,25].

The framework considers the design and construction of the RPA solution to be a part of the organization's intelligent process automation environment [7,15,21,25]. The organization implementing the RPA solution, should consider RPA within the context of any existing IT and intelligent process automation strategy.

The framework considers results evaluation to be any usage of the output of the RPA system to determine the existence of fraud and how best to prevent it from occurring in future.

The three high-level phases described in the framework involve various skills which are needed for the implementation of RPA. The skills will also differ between the process and audit environments.

The first phase, *Process Identification*, requires identifying processes for automation that requires process and audit expertise in the context of that specific process environment.

The second phase, *The RPA Design and Construction*, requires RPA development expertise, regardless of the environment the automation takes place in.

Lastly, *Results Evaluation* of the automated process will either cause changes to the implemented process to further reduce fraud in the process environment, or be used in audit analytics in the scope of the audit engagement.

This research confirms the cross-functional overlap in skills that is required for RPA implementation in the audit and the information technology environments [23,26], as indicated in Figure 1. There is no guarantee that all of the required skills will exist in an organization therefore, organizations should hire or contract in these skillsets and necessary RPA software when needed [14,15,19,22,25].

5 Conclusion

This systematic literature review has recognized a total of 22 articles that explain how RPA may offer ways for organizations to reduce the risk of fraud and advance audit effectiveness.

The content from the chosen articles were organized into six distinct themes that describe the role of RPA in auditing and fraud control.

These themes are: process automation - reducing the time spent by auditors and employees on mundane, repetitive tasks that allow for greater focus on challenging and value-adding tasks; the changing role of the auditor – proposing an expansion of auditor skills to include more technical skills required to make best use of RPA in auditing and fraud control; RPA vendors – that indicate most organizations make use of RPA vendors with the necessary skills and expertise to implement RPA solutions rather than embarking on in-house development; RPA threats – RPA implementations have an impact the governance, risk and control environment of organisations; process identification for RPA - processes automated identified for RPA should be structured or semi-structured in nature; data standardization - the successful use of RPA in organizations to address fraud and enhance audit interventions require strict data standardisation and governance considerations.

Finally, this review contributes to the body of knowledge by presenting a list of preconditions for the successful use of RPA in auditing and fraud control. Furthermore, a RPA implementation framework was proposed, that organizations, practitioners and researchers may consider in audit and fraud control environments.

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Design parameters of multidimensional reward systems based on preference analysis of Students of Business Information Systems (Bachelor and Master) at the University of Applied Sciences Northwestern Switzerland

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Abstract. In Switzerland, there is currently a major shortage of skilled workers in many companies and organisations. A particular bottleneck can be seen in the area of IT professions. The lack of qualified employees is a challenge for future education and training and intensifies the current competition for today's necessary and urgently sought talent in the IT sector. In this context, it will be crucial in the future how attractive and individualized compensation systems can be designed for potential employees. Needs-based compensation packages should help to attract and ultimately retain future IT professionals. The aim of this study is to measure the preferences of students of business informatics at the FHNW to analyse which elements of total rewards management are crucial for the choice of a future employer. The results will help companies optimise the total rewards system according to their needs or include those factors that can be expected to provide the best benefits for future employees. Thus, not only the total monetary value, but also the composition of financial and non-financial elements must be included in this overall consideration.
The aim is to provide decision-makers in organisations with targeted information that will allow them to design optimal incentive packages to be an attractive employer for students of business informatics or potential employees in the informatics field.

Keywords: Web-Tool Reward Design, Discrete Choice Analysis, Data driven Business Analytics, Flexible Wage Systems, Employer Attractiveness.

1 Introduction

There is currently a significant shortage of skilled workers in many companies and organisations. This situation can be observed among others, mostly in the field of IT-professionals. The lack of qualified employees is a challenge for future education and training and intensifies the current competition for today's necessary, and urgent-ly sought talent in the information sector. It will be crucial how attractive and indi-vidualised remuneration systems can be designed for potential employees in this context. Needs-oriented customised remuneration packages should help to attract and ultimately retain ITprofessionals. Employer brand Randstad's latest study (2021) has also shown

that companies should take a closer look at these questions because at-tractive salary and benefits remain the most important drivers overall. The discussion on the design of company-specific remuneration systems is broad and intensive to-day. However, this is often done from a purely corporate perspective. The question of how employees perceive and assess these remuneration systems is often ignored. The consideration of the remuneration from the employee side is essential from a scien-tific as well as a practical point of view. The perceived satisfaction with the remuner-ation system not only has a relevant influence on the attraction but also on the be-haviour and the attitude of the employees to their work and their employer.

In the concepts of total rewards (Thompson 2002, p.9), it is evident that nowadays a modern reward sys-tem will not only focus on the employee's payment but take more attractive non-financial benefits into account, like work-life balance, flexible working hours, the possibility to work at home, etc. The total rewards approach is an advanced human resources management model that supports enterprise development and increases the enterprise's attractiveness. This study aims to measure the preferences of students of computer sciences at the University of Applied Sciences and Arts (FHNW) to analyse which elements of total rewards are decisive for the choice of a future employer. In addition, the results provide decision-makers in organisations with specific infor-mation that allows them to design optimal incentive packages to be an attractive employer for students of computer sciences or potential employees in this industry. For the realisation of the project, a practice-oriented integration of partner companies is planned from the beginning. Therefore, the aim is to collect and analyse data and develop a web implementation that promises a successful transfer into practice and can also be evaluated in terms of its benefits.

For the analysis, we will use a discrete choice experiment (DCE). A discrete choice experiment is a choice or decision-based method for analysing consumer preferences. DCEs have become a common technique in economics, addressing a wide range of policy questions in the transport economy (Hensher et al., 2005, p. 693), environmental economics (Hanley et al., 2001, p. 436) and health economics (de Bekker-Grob et al., 2012, p. 153). In human resource economics, preference measurement has only found its way into the field in recent years. This study aims to expand the research aspect to include individualisation and flexibility in remuneration based on the total reward model.

The following practice-relevant questions are to be answered:

- Which design parameters of a multidimensional compensation package are essential for computer sciences students when choosing a future employer?
- How likely are respondents to accept a job with specific attributes?
- Are there different design parameters depending on the age, gender, or other relevant factors of the students included in the decisions and can thus lead to additional employer benefits?

Knowing these job preferences of computer sciences students can finally help better understand the significant attributes for them.

Discrete Choice Model design

For the analysis of the design parameters of multidimensional reward systems, the different factors, being preferences that influence the acceptance decision for a job, are examined. This method goes beyond traditional qualitative assessments and provides quantifiable data that can better guide the selection of the most appropriate strategies for recruitment. It also goes beyond traditional ranking and rating exercises, which do not provide information on the strength of preference or trade-off. The method derives from Characteristics Theory of Value (Lancaster, 1966, p. 133; Aus-purg and Liebe, 2011, p. 305) and Random Utility Theory (McFadden, 1974, p. 106). Based on the above, utility is presented as a function of an alternative's characteris-tics and the person-specific characteristics of the decision maker. In this way, student n will choose job i if the following condition is met:

$$U_{ni} > U_{nj} \quad \forall i \neq j \in \tag{1}$$

The random utility model assumes that utility (U_{nj} = denotes the utility for alternative j at decision maker n) consists of two components:

- V_{nj} = explainable benefit, which can be observed and in an…
- ϵ_{nj} = unobservable variable (this latent variable consists in characteristics such as un-traceable properties of the service, or product such as unapparent differences or er-rors in the measurement itself).

The benefit for the students, taking into account the mentioned components for job i, can be defined as follows,:

$$U_{ni} = V_{ni} + \varepsilon_{ni} = f(\alpha_1 + \beta_1 x_{1n} + \beta_2 x_{2n} + \ldots + \beta_m x_{mni} + \varepsilon_n) \tag{2}$$

β in this case provides the preference variable for each specification of the job. Since the total utility cannot be determined directly, the probability (P) with which students n will prefer job i to job j is examined:

$$P_{ni} = \mathrm{P}\,(U_{ni} > U_{nj}) \quad \forall i \neq j \in \tag{3}$$

Before defining the characteristics and their attributes, the underlying preference structure model must be specified. Since in the present study not every characteristic can be objectively graded in terms of utility between the individual characteristics, a partial utility model is used as a basis and is consequently described by a determinis-tic and a probabilistic term.

It is planned to analyze the stated preferences of the respondents. Stated prefer-ences mean that the preference of the students towards different alternatives is di-rectly evident under experimental conditions since a limited number of choices (choice set) is presented. In contrast, revealed preferences mean the real situation where the set of alternative choices is not apparent. The disadvantages of the stated preference method are:

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- respondents are faced with a hypothetical choice without having to experience the direct consequences of their choice (do respondents take the survey seriously enough?)
- difficulty of a real representation of the labour market situation
- large heterogeneity among the respondents

We want to minimise the first disadvantage by using a sensitivity analysis (some classes of the business informatics courses are thus surveyed repeatedly). We plan to address the second point with expert interviews and focus group discussions and thus be sure that we only map choice sets that also correspond to reality. Since we are conducting the survey among business informatics programs at the FHNW, we can conduct an initial survey with a relatively homogeneous group.

We plan to implement three discrete choice procedures to analyse stated prefer-ences and methodologically adhere to Greene (2005 and 2010).

1. Mixed Multinomial Logit and Latent Class Modelling
2. Bayesian Hierarchical Modelling
3. Generalised Multinomial Logit

At present, the alternatives mentioned (Latent Class Models, Bayesian Hierarchical Modeling, Generalised Multinomial Logit) are no longer so computationally intensive and thus offer a valuable possibility to obtain additional information within the scope of a sensitivity analysis.

In addition, the extended models under points 2 and 3 are less constrained with respect to modelling assumptions. For example, the most commonly used mixed multinomial logit procedure is based on the so-called Independence of Irrelevant Alternatives (IIA) assumption. A consequence of this assumption is that a standard logit model is not always appropriate since it assumes that there is no correlation between unobserved factors and choice alternatives. The fulfillment of the IIA assumption can be checked with a Hausman test. If the assumption is not fulfilled, further mod-eling approaches can be used (points 2 and 3 from the previous list). This extended modeling ensures that the model finally used allows a concrete and scientifically sound transfer to practice, and verifies the best research methods are used for evalua-tion.

Preference measurement and implementation of the analysis – stated choice experiment.

The design parameters defined using expert discussions and focus group interviews are transferred into so-called "choice sets". In this process, hypothetical job offers are generated based on the possible characteristics of the performance parameters' levels and presented to the participants for selection.

For illustration purposes, a selection from a possible choice set is shown below in the simplified form. For this example, we can hypothetically specify the following attributes:

- Place of work with 4 levels: 4600 Olten, 8152 Glattbrugg, 4001 Basel and 6110 Wolhusen (LU)
- Annual salary (100%) with 5 levels: 72'000, 78'000, 84'000, 90'000, 96'000 CHF
- Weekly working hours 100% with 4 levels: 36h, 38h, 40h, 42h
- Number of holiday weeks 100% per year with 3 levels: 4 weeks, 5 weeks, 6 weeks
- Expected workload (workload flexibility) with 5 levels: 60%, 80%, 100%, 60-80%, 80-100%
- Home office with 3 levels: no home office, 1 weekday home office, 2 weekdays home office

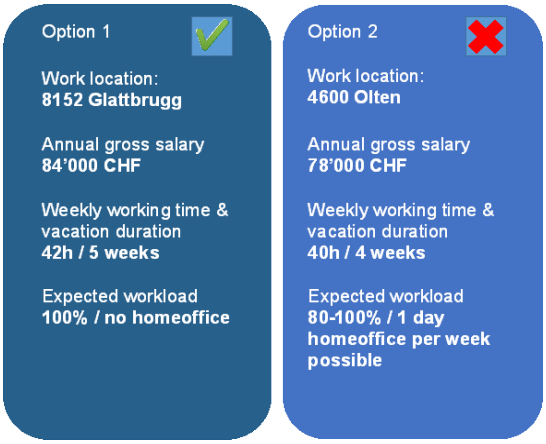

Fig. 1. Illustrative example of a choice set for measuring the monetary valuation of multidimensional reward systems

Even this relatively simple (hypothetical) configuration allows the design of 4·5·4·3·5·3=3600 different choice cards. However, the participants cannot judge 3600 choice cards (with 3600 choice cards; there are $\frac{3600 \cdot 3599}{2} = 6.5$ millions binary choice tasks).

This problem can be solved in different ways:

Restriction of the choice cards: In the above example, it is not plausible that, for example, an expected workload of 60% or 60-80% would appear together with the option of 2 weekdays home office. Moreover, salary and workplace will correlate: In Zurich and Basel (metropolitan areas), the wage tends to be higher than in peripheral areas (e.g. Olten or Wolhusen). We will find out more about these restrictions in indi-vidual interviews with recruiting experts from ICT companies in the region to ensure that only practice-relevant choice-sets are represented in the survey.

Experimental design: In addition to the complete design just presented (3600 choice cards) and a possible reduced design, there is the possibility of orthogonal, fractional or optimal (efficient) design. These algorithms allow a further considera-ble(!) reduction of the choice set that a respondent has to answer (typically 5-15). However, the disadvantage of reduced designs to full designs is that only main ef-fects and no

interactions can be estimated. In addition, participant-specific covari-ates are asked, such as mode of study (full-time vs. part-time), gender, age, migration background, work experience and family situation.

Using suitable software packages (Stata and R), the study design is formed according to criteria commonly used in practice. These criteria include, for example, the optimal D-efficiency of the study design, which is influenced by the number of choic-es presented in the choice experiment and the number of participants. Also, the choices' values must have a minimum overlap (within a choice set, the values should be used as often as possible and in a balanced way).

We assume a priori that we will present one person with about 12 choices (target group of business information technology students. Currently, there are 6 classesin the Bachelor's programme and 2 class courses in the Master's programme with 30-40 participants per class so that the necessary sample size of n=300 can be achieved (Louviere et al. 2000).

Survey: Once the experimental design is fixed, the choice cards for the partici-pants will be formed. We plan to use the Questback survey tool (browser-based) to conduct the choice experiment. During the experiment, the database with the answers will be automatically expanded. The advantage is that the survey becomes easily scalable. After completing the first phase with students from FHNW, we plan to in-volve other technical courses at universities of applied sciences and universities (in-cluding Kalaidos FH, ZHAW, BFH, HSR, FHGR and the business engineering courses at ETH Zurich).

The illustration below shows the above choice set on a smartphone or laptop / iPad. If a user selects option 1 (green tick on the left), the database is displayed as follows:

Fig. 2. Choice sets displayed in an illustrative web tool

Table 1. Illustrative data set collected after completing a choice card by individual 131

ID	year	mode	gender	nationality	age	…	location	salary	weekly work-time (hours)	holidays (weeks)	workload (%)	home-office (days p. week)	choice
131	2021	ft	m	CH	26	…	8152	84 K	42	5	100	0	1
131	2021	ft	m	CH	26	…	4600	78 K	40	4	80	1	0
131	2021	ft	m	CH	26	…	DROPOUT-OPTION						0

The "third" option in the last data line is a dropout option, i.e. the non-selection of both proposed alternatives.

Emission of results to ICT companies and future developments, transfer to research and teaching.

The aim of the first data collection among business informatics students at the FHNW is to calibrate a multivariate discrete choice model. The purpose is, among other things, the monetary evaluation of design parameters x_j of employment contracts. This can be expressed via the marginal rate of substitution with non-monetary covariates x_j:

The unit of measurement of the marginal rate is $\frac{\Delta S}{\Delta x_j}$. It indicates how much salary can be foregone on average (ΔS), if an attribute of the employment contract changes (Δx_j), for example, one day more home office per week is granted. This information allows ICT companies to optimally design employment contracts via non-monetary components such as working time flexibilisation, etc.

For this purpose, the data set (anonymised) is stored in a specially programmed web tool as a prototype with the calibration algorithm. In follow-up projects, this web tool will be made available to companies so that the continuously updated monetary evaluations of the design parameters of employment contracts by students can be visualised on the basis of the surveys collected and the preferences derived from them.

Planned functionalities: A user of the web tool can stratify the data set according to his or her wishes, for ex-ample, by only evaluating the attributes of female students. For example, women may value a working day in a home office higher than men, but men may value a lower working time per week monetarily higher. Thus, users can create hypothetical employment contracts with design parameters via a drop-down menu and estimate individual performance parameters' monetary effects (including estimation uncer-tainties) utilizing graphical visualizations.

Planned further developments and transfer of the results: This study's result can be a database for corporate and organisational decision-makers who want to understand better the relative importance of different attributes for choosing a job in information systems. Companies and organisations can create adequate total compensation packages based on the quantitative information from the DCE. Such information as the

stated preferences of business informatics students will also be important for designing appropriate recruitment and retention strategies.

After successfully completing this initialisation project, the project steps and the results will also be presented in the textbook "Statistik im Klartext" (author Fabian Heimsch). Concerning research, much has been published in the context of DCE applications. However, the project provides new and innovative insights, especially for human resource management, to promote employer attractiveness and employee loyalty in the context of total rewards management. The use with regard to sensitivity analyses, e.g. Bayesian Hierarchical Modelling, can also be published in peer-reviewed scientific and practice-oriented journals.

In addition, an expansion of the basis via other universities of applied sciences and universities is planned (e.g. ETH Zurich, University of Applied Sciences Rap-perswil, University of Applied Sciences Chur, etc.). This will further increase the use-fulness of the web tool for companies (e.g. ICT companies in the canton of Grau-bünden are more likely to want to align themselves with the responses of the students of Graubünden). Furthermore, the data and answers can be used to identify any changes in ICT students' preferences over time and publish these through the appro-priate channels.

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Role of Innovation Competitive Advantage on Strategic Orientation Dimensions and Sustainable Growth of SMEs in Nigeria

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Abstract

The purpose of this study was to examine the role of innovation competitive advantage on strategic orientation dimensions of (entrepreneurial orientation, market orientation, and resource orientation) on the sustainable growth of SMEs. This study used a total of 217 responses adopting the cross-sectional survey research design from manufacturing SMEs owners/founders. The results were analysed using PLS-SEM via SmartPLS version 3.3.3. The major findings established that entrepreneurial orientation did not directly link with the sustainable growth of SMEs. The study confirmed that market orientation and resource orientation revealed a direct and significant positive link with the sustainable growth of SMEs. Similarly, innovation competitive advantage has a direct significant positive association with the sustainable growth of SMEs. Likewise, entrepreneurial orientation and market orientation have a direct and significant positive relationship with innovation competitive advantage. However, resource orientation did not significantly relate to innovation competitive advantage. The findings validated that innovation competitive advantage mediated the relationship between entrepreneurial orientation, market orientation, and the sustainable growth of SMEs. Finally, innovation competitive advantage did not mediate between resource orientation and sustainable growth of SMEs, which have not previously been proven in empirical studies. This study was designed to address the existing gaps and provide reasons to prove them. This study is indeed one of the remarkable studies in the context of SMEs, which integrates these selected variables into a single model. The originality focused on the role of innovation competitive advantage on strategic orientation dimensions and sustainable growth of SMEs that are relevant to Society 5.0.

Keywords: Entrepreneurial orientation, Market orientation, Resource orientation, Innovation competitive advantage, sustainable growth of SMEs.

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1. Introduction

Integrating sustainability into enterprise strategic planning is necessary for modern changing landscape. A value-driven approach may be crucial to sustaining long-term growth in the development of business strategies. Therefore, the sustainable growth of SMEs reflects the product of the founders' strategic choices and the external environment dynamic attributes (Wawira, 2013; Sony, 2019; Srisathan et al., 2020). The SMEs are uprising at various rates in any climate or business context. Such success inconsistencies indicate that entrepreneurs' strategic choices can influence the enterprise growth; SMEs make up 99% of all companies (Sustainability Knowledge Group, 2019). In addition, they contribute 70% of global jobs and the major contributors to value manufacturing SMEs, contributing between 50% and 60% of the

estimated value-added. The SMEs total employment is up to 45% and 33% GDP in developing economies (Sustainability Knowledge Group, 2019). These data clearly show that the position of SMEs in sustainable growth is crucial to realise the sustainability goal, which confirms the bond between SMEs and sustainability (Silvestre, & Ţîrcă, 2019). The achievement of small and medium enterprises (SMEs) in a country is a key area of study. The incredible success or lack of progress of small and medium enterprises in every economy is important to the success of such an economy (Schmitt, 2018). In view of this, past research has shown that absolutely far-reaching empirical model still remain to be found to illustrate the sustainable growth of SMEs and the ways they should grow to succeed (Diaz et al., 2021) Therefore, not much has been detailed in respect of sustainable growth of small and medium enterprises. Baker (2014) found that innovation simply refers to total creativity, improvement, invention and the involvement of everyone in the enterprise in new ideas for the advancement of the organisation. Since growth across borders and global competitiveness has strengthened, the importance of innovation has grown and has become a core necessity central to an enterprise's sustainable growth performance in the indigenous or local and foreign marketplace (Saqib, & Satar, 2021). In other sittings Sheng et al., (2013) maintained that knowledge stickiness had shown a significant effect on innovation competitive advantage, and knowledge transfer also had a significant impact on innovation competitive advantage. Therefore, the role of innovation competitive advantage on strategic orientation dimensions of entrepreneurial orientation, market orientation and resource orientation with sustainable growth of SMEs has not been addressed in the prior work of scholars. Similarly, Society 5.0 has emerged as a result of rapid innovation of interconnected devices, which are now extremely sophisticated and widely used around the world, and it has managed to cause a massive culture shift (Salgues, 2018), which has an influence on sustainable growth of SMEs especially in the context of Nigeria. Thus, these motivational Knowledge gaps would be ascertained in addition to lack of empirical research on the effects of entrepreneurial orientation, market orientation, resource orientation and sustainable growth of SMEs in Nigeria. This study is needed because it attempt to investigate the role of innovation competitive advantage in the bond between strategic orientation dimensions such as entrepreneurial orientation, market orientation and resource orientation on the sustainable growth of small and medium enterprises (SMEs) in Nigeria.

2. Literature Review and Hypotheses Development

2.1 Theory

The dynamic capabilities theory was employed in this study. Dynamic capabilities theory (DCT) maintains that competitive gain of enterprises can be centred on unique processes, ways of coordinating and combining, shaped by the precise level of investment about the organisation, (Tecee et al., 1997), such as the hard-to-trade knowledge business plan, additional value of the enterprise and the paths of transformation that it has engaged. Entrepreneurial orientation (Sharma, & Kumar, 2021), market orientation (Fitriany et al., 2020), resource orientation (Paladino, 2007) and innovation competitive advantage (Sheng et al., 2013) are currently viewed as dynamic capabilities and robust strategies that can foster sustainable growth of SMEs

(Teece, 2007; Nimfa et al., 2019). Academics such as Teece (1997); Newey and Zahra (2009) had advanced dynamic capability theory and their claims and models. While these scholars have placed great importance on the development of business strategies aimed at entrepreneurship, technology, knowledge management, innovation and sustainable profitability, they have not sufficiently incorporated viable practices such as the sustainable growth of SMEs into their models. From the context of SMEs, previous studies have identified the entrepreneurial orientation (Nofiani et al., 2021) market orientation (Randhawa et al., 2020); resource orientation (Sahi et al., 2020), and innovation competitive advantage (Sheng et al., 2013, Whalen, & Han, 2017) as basic capabilities, smart enough to foster sustainable growth of SMEs. From the viewpoint of dynamic capabilities theory, numerous intensities of entrepreneurial orientation, market orientation, resource orientation and innovation competitive advantage provide available capabilities and resources that can promote sustainable growth of SMEs (Teece, 2007; Hussain et al., 2020; Gutierrez Rodriguez et al., 2020). This study has contributes to improving the effectiveness of dynamic capabilities theory that SME owners/founders who embrace an entrepreneurial orientation, market orientation and resource orientation; and innovation competitive advantage, can witness the continued delivery of sustainable growth of SMEs and improved business efficiency. Accordingly, this research adopted the dynamic capabilities theory as the basis for explaining the relationship between the variables chosen in the framework to underpin the theoretical lenses, as shown in Figure 1.

2.2 Entrepreneurial Orientation and Sustainable Growth of SMEs.

Entrepreneurial orientation makes a firm quite willing to take advantage of opportunities (Stephens, & Kim, 2015). Previous literature on entrepreneurial orientation (EO) Ali et al. (2020) indicated that entrepreneurial orientation, market orientation, and total quality management are positively and significantly related to the organisational sustainable growth of SMEs. Accordingly; Beliaeva et al. (2020) found that there was a positive influence of entrepreneurial orientation and relatively insignificant effect of market orientation as component of strategic orientation. Kumar and Das (2020) reported that entrepreneurial orientation was mast related with the selection of new added value or in the face of growing competition. Covin and Wales (2019) noted that entrepreneurial orientation is part of a new business that has a strategic orientation based on the extent to which the company has a sustained risk-taking structure of appropriate strategic behaviour. In addition, entrepreneurial orientation in new enterprises could indeed grow while acquiring essential low-cost economic resources and converting them into high-value imitative products where competitive environments are not balanced (Yin et al., 2020; Nimfa & Gajere, 2017). This occurred due to difficulties in obtaining resources to sustain business operations, economic expansion and technological innovation (Cui et al., 2018; Ying et al., 2019). Hence, this study hypothesised that:

H1: Entrepreneurial orientation (EO) has a direct positive effect on sustainable growth of SMEs.

2.3 Market Orientation and Sustainable Growth of SMEs.

Narver and Slater (1990) claimed that a firm that enhances its own market orientation would also strengthen market growth through business segments made up of primary commodities and non-commodity products. In other words, it must build a sustainable

and remarkable value for the customer (Silbergh, 2019). Recent studies has revealed that higher-level market orientation dimensions have a significant effect on the performance of women-owned small and medium enterprises (Porter, & Kramer, 2019). Dogbe et al. (2020) found that market orientation is dedicated to the recognition of market dynamics and the exchange of knowledge with organisational members in order to deliver the best strategic orientation initiatives to the customer. Sahi et al. (2020) confirmed that the level of market orientation for operating activities as part of the strategic direction was significant. However, market orientation and entrepreneurial orientation do not have a positive and significant impact on strategic orientation and business performance (Novita et al., 2020). Conversely, this link continue to be stronger under strategic decision responsiveness and higher-level dimensions of entrepreneurial orientation (Yu et al., 2019). Thus, this study stated that:
H2: Market orientation (MO) has a direct positive effect on sustainable growth of SMEs.

2.4 Resource Orientation and Sustainable Growth of SMEs.
The resource orientation also showed significant and positive interactions with all four performance measures evaluated, and most of these relationships were strengthened by the conditions of the industry (Chmielewski, & Paladino, 2007). Likewise, survey on resource orientation revealed a positive and significant relationship with performance indicators that were assessed in an industrial conditions that support resource capabilities (Cheng et al., 2020). Resources and capacities must have unique characteristics before making a significant contribution to the strategic advantage of the firm (Teece, et al, 1997). The decision on resource orientation for innovation should be at a strategic level as the organisational strategy is largely restricted and dependent on the firm's resource profile' (Zhang, & Walton, 2017). Literature review on resource orientation showed that resources and capabilities are sources of sustained value when they are valuable. In addition, valuable resources allow the enterprise to develop and implement strategies to improve its operational efficiency (D'Amato et al., 2020; Alnawas, & Farha, 2020). Therefore, the hypothesis of this study suggested that:
H3: Resource orientation (RO) has a direct positive effect on sustainable growth of SMEs.

2.5 Relationship between the Role of Innovation Competitive Advantage and Entrepreneurial Orientation, Market Orientation and Resource orientation on Sustainable Growth of SMEs
Previous studies have attempted to acknowledge the direct and significant link between innovation competitive advantage and sustainable growth of SMEs (Whalen, & Han, 2017). Sheng et al. (2013) indicated that transfer of knowledge had a strong association with innovation competitive advantage. In a similar vein, current research has confirmed that innovation competitive advantage has a direct affiliation with organisational culture; and innovation competitive advantage partially mediates the connection between organisational culture and sustainable growth of SMEs (Nimfa et al., 2021a). Studies have also shown that entrepreneurial orientation has an important connection with innovation-oriented enterprises (Al Mamun et al., 2018; Kiyabo, & Isaga, 2020). On the other hand, Ledwith and O'Dwyer (2008) outlined some clear

differences between the influence of product release, market orientation and product advantage on product capabilities and business quality in small and large enterprises. Research findings have shown that resource orientation is positively linked to progress and innovation of new products, while the sustainable use of resources promotes the business's technology capabilities (Paladino, 2007; Kumar et al., 2012). Woschke et al., (2017) stated that resource imbalance would have a progressive impact on accelerated growth, but not technological innovation in SMEs. Based on the above discussion, there is a limited empirical survey on the mediating role of innovation competitive advantage between entrepreneurial orientation, market orientation and resource orientation, and sustainable growth of SMEs. Accordingly, the following hypotheses were suggested:

H4: Innovation competitive advantage has a direct positive effect on sustainable growth of SMEs.

H5: There is a significant relationship between entrepreneurial orientation and innovation competitive advantage.

H6. There is a significant relationship between market orientation and innovation competitive advantage.

H7. There is a significant relationship between resource orientation and innovation competitive advantage.

H8: Innovation competitive advantage mediates between entrepreneurial orientation and sustainable growth of SMEs.

H9: Innovation competitive advantage mediates between market orientation and sustainable growth of SMEs.

H10: Innovation competitive advantage mediates between resource orientation and sustainable growth of SMEs.

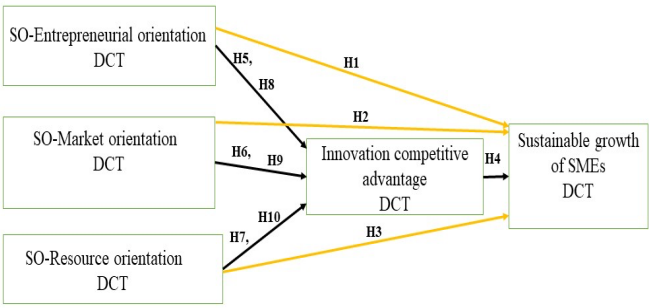

Figure 1: Theoretical Framework

3. Methodology

The current research is empirical (based on primary data), descriptive (analysis of the relationship between variables). Deductive (testing of hypotheses), and quantitative (involves analysis of quantitative data collection using a structured questionnaire). The population of the study includes manufacturing SMEs, enterprise year of incorporation, employees, enterprise assets based, highest qualification and owner responsibilities. Based on the most recent data provided by Manufacturers Association of Nigeria (MAN, 2017), the Nigerian manufacturing sector consists of 3,012 manufacturing firms, presently registered in official directory records. These firms are part of a broad spectrum of business sizes.

3.1 Measurement

The analysis of the suggested theoretical framework was carried out using the accepted and validated questionnaire from previous empirical studies with a few adjustments to fit the current study outlined in Table 1. Five points Likert scale used for measuring all variables 1 = strongly disagree and 5 = strongly agree. In order to assess whether the theoretical and practical eligibility criteria have been met, copies of the research instrument (questionnaire) were sent to 3 practitioners and 3 scholars. Five research variables, items used as measurement and sources are outline in Table 1. The structured questionnaire covers a total of 27 questions used to measure 5 study variables. All variables were used as Mono-dimensional variables.

Table 1 Measurement of Study Variables

Variable	Items	Source

1.Entrepreneurial orientation Mono-dimensional construct	5	(Cheng & Huizingh, 2014; Gatignon & Xuereb, 1997)
2. Market orientation Mono-dimensional construct	6	(Gatignon & Xuereb, 1997; Narver & Slater, 1999)
3. Resource orientation Mono-dimensional construct	6	Paladino (2007, 2008)
4. Sustainable Growth of SMEs	6	Arora, Kumar & Thapar (2018); Eggers et al., 2013)
5. Innovation competitive Advantage	6	Sheng et al., 2013; Nimfa et al., 2020.
Total number of items	27	

3.2 Data collection

A list including the contact details of most of the initial population of 3012 manufacturing firms was obtained from the official Manufacturers Association of Nigeria (MAN) website. Initial contact via telephone call was placed to roughly 1124 of these firms using a simple random sampling method. The unit of analysis used was organisational (the owners/founders) who has the strategic knowledge of the SMEs. The structured questionnaire was administered to 540 manufacturing firms that decided to participate in the research, together with a cover letter consisting of all required clarifications. The mail survey, which was sent to the respondents via a Google form, was the data collection technique used in this study.

Only 217 usable copies of the questionnaire were returned from these firms, response rate was 40.19 percent and population-wide representation was 7.20 percent. Owing to their pragmatic knowledge of strategic management of manufacturing companies, owners were selected as the primary respondents. A number of respondents, 20% of organisational research work is considered acceptable (Saleh & Ndubisi, 2006; Rogelberg & Stanton, 2007). The SMEs survey rate of response in developing countries (for example, Nor-Aishah et al., (2020) received 146 (14.6 percent), Basah (2018) received 203 (20.83 percent), Ghobakhloo & Ching (2019) received 177 (32.82 percent), and Ebrahim et al., (2012) received 256 (20.8 percent) these were considered acceptable. Therefore, the response rate of 217 (40.19 percent) for this study was considered acceptable in research. The methods of data analysis used for this study was Partial Least Square Structural Equation Modelling (PLS-SEM) with the aid of SmartPLS statistical software analysis (Hair et al., 2019a, 2020).

4. Discussion and Conclusion

The descriptive analysis shows that more than half of the respondents 139(64.1%) owners/founders and only 78(35.9%) were senior management employees had participated in this analysis. The highest qualification possessed by 116 (53.5%) respondents had no degree but were skilled, whereas 101 (46.5%) respondents were bachelor degree and above. Followed by the assets (excluding land and buildings) for 138 (63.6%) SMEs are between 5 million Naira and less than 50 million Naira, while 79 (36.4%) SMEs documented assets worth between 50 and below 500 million Naira. Amongst the SMEs, 113 (52.1%) and 104 (47.9%) hired 10-49 and 50-199 full-time

employees, accordingly. The majority of the respondents 163 (71.5%) SMEs had been recognised for 5 years or more incorporation, while 54 (24.9%) SMEs had been incorporated in less than 5 years. Table 2 provides a demographic information summary of the results as follows:

Table 2 Demographic Information

Items		Frequency	Percentage (%)
1. Your responsibility in the enterprise	Owner/Founder	139	64.1
	Senior Management Employee	78	35.9
	Total	**217**	**100**
2. Your highest qualification	Bachelor degree and above	101	46.5
	No degree/skilled	116	53.5
	Total	**217**	**100**
3. What is your enterprise assets based (excluding land and building)	5 million Naira to < 50 million Naira	138	63.6
	50 million Naira to < 500 million Naira	79	36.4
	Total	**217**	**100**
4. How many full-time employees are hired in your enterprise?	10 – 49	113	52.1
	50 – 199	104	47.9
	Total	**217**	**100**
5. How long has your enterprise incorporated?	Less than 5 years	54	24.9
	5 years or more	163	71.5
	Total	**217**	**100**

4.1 Measurement Model Assessment

In order to assess the model, this study used the Partial Least Squares method to the structural equation model (Hair et al., 2019a). The statistical software used was the SmartPLS version 3.3.3, which generates an incremental combination of the main method of analysis that relates to construct measurements and path analysis that captures the structural model of all constructs. The Partial least squares (PLS) approach was considered most appropriate, mainly based on small sample size (Hair et al., 2019b). This study used 217 sample size, and a bootstrapping process with 500 samples of data was used. A study by (Hair et al., 2017a) recommended a two-step process when evaluating PLS-SEM. This approaches include determining measurement model and assessing structural model. Henseler (2017) stated that it may be irrelevant to assess the structural model without first evaluating the measurement model. Therefore, this study considered the evaluation of measurement model prior to the assessment of the structural model (Hair et al., 2017b). The findings revealed that the composite reliability (CR) value for sustainable of SMEs was 0.903. Meanwhile, the composite reliability (CR) value for innovation competitive advantage was 0.859, followed by entrepreneur orientation (0.914), market orientation with 0.893 and resource orientation with 0. 901 as illustrated in Table 3. The Cronbach Alpha value for sustainable growth of SMEs was 0.866 which indicates excellent internal consistency. Meanwhile, the Cronbach Alpha value for innovation competitive advantage was 0.782, which indicates good internal consistency. The Cronbach Alpha value for entrepreneurial orientation was 0.874, market orientation with 0.840 and

resource orientation was 0.863 which all indicated excellent internal consistency (Hair et al., 2019a), shown in Table 3 and Figure 2:

Table 3 Construct Reliability and Validity

	CA	CR	AVE
EO	0.874	0.914	0.726
ICA	0.782	0.859	0.604
MO	0.840	0.893	0.676
RO	0.863	0.901	0.647
SGSMEs	0.866	0.903	0.652

Note: EO = Entrepreneurial orientation, ICA = Innovation Competitive advantage, MO = Market Orientation, RO = Resource Orientation, and SGSMEs = Sustainable Growth of SMEs.

Convergent-validity assessed by AVE for sustainable growth of SMEs was 0.652, followed by innovation competitive advantage with 0.604, entrepreneur orientation with 0.726, market orientation was 0.676 and resource orientation with 0.647 as illustrated in the Table 3 above. Discriminant validity was measured using the Fornell-Larcker Criterion for this model (Hair et al., 2019a) as shown in Table 4. The findings indicate that for all reflective constructs, the square root of average variance extracted [AVE] (diagonal) was higher than the causal relationships (off-diagonal).

Table 4 Fornell-Larcker

	EO	ICA	MO	RO	SGSMEs
EO	0.852				
ICA	0.809	0.777			
MO	0.855	0.841	0.822		
RO	0.843	0.794	0.848	0.804	
SGSMEs	0.865	0.844	0.904	0.903	0.807

Note: EO = Entrepreneurial orientation, ICA = Innovation Competitive advantage, MO = Market Orientation, RO = Resource Orientation, and SGSMEs = Sustainable Growth of SMEs.

4.2 Structural Model Assessment

When the reliability and validity of the measurement model was achieved, the structural model was examined. The path coefficient (hypothesis test) as well as the coefficient of determination (R2 value) were tested in the structural model. In this study, the coefficient of determination (R2 value) was 0.894 (89.4%) and 0.745 (74.5%) for sustainable growth of SMEs and innovation competitive advantage. In order to evaluate the path coefficient (hypothesis tested), a single-tailed SmartPLS test with a 5 percent significance level was performed to evaluate the P value and T statistics to test the significance or insignificance of the hypotheses. Baron and Kenny (1986); MacKinnon, (2011) has been used to test the relationship between entrepreneurial orientation, market orientation, resource orientation, and sustainable growth of SMEs with any mediation effect of innovation competitive advantage. The findings of the structural model, referred to as the inner model, are shown in Table 5.

The first hypothesis of this study, H1 has predicted that entrepreneurial orientation did not have a direct significant positive link with sustainable growth of SMEs, therefore it

was not supported at a 0.01 level of significance (β= 0.118, t= 1.676, p>0.05) as illustrated in Table 5. Hypothesis 2 (H2) of this study confirmed that market orientation has a direct and significant positive link with sustainable growth of SMEs (β=0.334, t= 3.100, p<0.01), therefore, H2 was strongly supported. Also, H3 revealed that resource orientation has a direct significant positive connection with sustainable growth of SMEs, the results was strongly supported with (β= 0.391, t= 4.128, p<0.01). The fourth hypothesis of this study, indicated that innovation competitive advantage has a significant positive association with sustainable growth of SMEs, which was supported at a value 0.01 level of significance (β= 0.163, t= 2.890, p<0.01). Furthermore, in hypothesis 5 (H5), show a significant relationship between the entrepreneurial orientation and innovation competitive advantage. Based on the findings, entrepreneurial orientation has a direct significant and positive relationship with innovation competitive advantage (β= 0.235, t= 3.093, p<0.01). Based on hypothesis (H6), the result shows that market orientation has a direct and significant positive relationship with innovation competitive advantage, that was supported at a value 0.01 level of significance (β=0.495, t= 4.333, p<0.01). On the other hand, hypothesis 7 (H7), results show that resource orientation did not significantly relate to innovation competitive advantage (β=0.182, t=1.829, p>0.05), hence H7 was not supported. Furthermore, hypothesis (H8), indicated that innovation competitive advantage mediates the between entrepreneurial orientation and sustainable growth of SMEs, therefore, the result was supported by a 0.05 level of significance (β=0.038, t=2.010, p<0.05). Hypothesis nine (H9), revealed that innovation competitive advantage mediates the relationship between market orientation and sustainable growth of SMEs, the result was supported by a 0.01 level of significance (β=0.081, t= 2.665, p<0.01). Finally, hypothesis ten (H10), confirmed that innovation competitive advantage did not mediates between resource orientation and sustainable growth of SMEs, therefore, the result was not supported at 0.01 level of significance (β=0.030, t=1.556, p>0.01).

Table 5: Path Coefficient

	Original Sample	Sample Mean	STDEV)	T Statistics	P Value
1. EO -> SGSMEs	0.118	0.105	0.070	1.676	ns0.094
2. MO -> SGSMEs	0.334	0.347	0.108	3.100	**0.002
3. RO -> SGSMEs	0.391	0.400	0.095	4.128	***0.000
4. ICA -> SGSMEs	0.163	0.150	0.056	2.890	**0.004
5. EO -> ICA	0.235	0.225	0.076	3.093	**0.002
6. MO -> ICA	0.495	0.511	0.114	4.333	***0.000
7. RO -> ICA	0.182	0.177	0.099	1.829	ns0.068
8. EO -> ICA -> SGSMEs	0.038	0.034	0.020	2.010	*0.045
9. MO -> ICA -> SGSMEs	0.081	0.075	0.030	2.665	**0.008
10. RO -> ICA -> SGSMEs	0.030	0.027	0.019	1.556	ns0.120

Note: Entrepreneurial orientation, ICA = Innovation Competitive advantage, MO = Market Orientation, RO = Resource Orientation, and SGSMEs = Sustainable Growth of SMEs.
P values asterisks: ns = P > 0.05; * = P ≤ 0.05; ** = P ≤ 0.01; *** = P ≤ 0.001

5. Conclusion

This study examined the role of innovation competitive advantage on strategic orientation dimensions of entrepreneurial orientation, market orientation and resource orientation on sustainable growth of SMEs. The initial assessment was to demonstrate the variable links between entrepreneurial orientation, market orientation, resource orientation and sustainable growth of SMEs. In addition, this study investigates the role of innovation competitive advantage between entrepreneurial orientation, market orientation and resource orientation on sustainable growth of SMEs a path not previously established by scholars (Tajeddini et al., 2020; Diabate et al., 2019). The empirical findings have shown that entrepreneurial orientation did not have a direct significant link with sustainable growth of SMEs. The study confirmed that market orientation and resource orientation revealed a direct and significant positive link with sustainable growth of SMEs. Similarly, it was also found that innovation competitive advantage has a direct significant positive association with sustainable growth of SMEs. Relatedly, the results proved that entrepreneurial orientation and market orientation have a direct and significant positive relationship with innovation competitive advantage. Nevertheless, resource orientation did not significantly relate to innovation competitive advantage. Accordingly, the findings demonstrated that innovation competitive advantage mediated the relationship between entrepreneurial orientation, market orientation and the sustainable growth of SMEs. Finally, it was reported that innovation competitive advantage did not mediates between resource orientation and sustainable growth of SMEs, which have not previously been proven empirical studies. Also, the findings revealed that innovation competitive advantage has a significant positive association with sustainable growth of small and medium enterprises. This finding is consistent with the views of previous studies (like Sheng et al., 2013; Nimfa et al., 2021a). These results indicate that when entrepreneurial-oriented SME managers are involved in promoting innovation competitive advantage pathways that are particularly beneficial to SMEs, and dynamic capabilities in nature, sustainable growth of small and medium enterprises would certainly succeed (Whalen & Han, 2017). In addition, entrepreneurial orientation and market orientation did not have a direct significant connection to sustainable growth of SMEs, which could be the result of tougher regulations and global pandemics where SMEs are strategizing for success in business before thinking about sustaining SMEs (Islam, & Wahab, 2021b)

In this study, results of the mediation analysis, found that innovation competitive advantage mediates the relationship between entrepreneurial orientation, market orientation and sustainable growth of SMEs. This outcome was in tandem with the views of existing studies, such as (Nofiani et al., 2021; Dickel, 2018) who disclosed that innovation and ambidexterity of social networks mediates the link between entrepreneurial orientation and performance of small and medium enterprises. Finally, the results confirmed that innovation competitive advantage did not mediate between resource orientation and sustainable growth of SMEs. This study contributes to the growing literature on innovation competitive advantage, sustainable growth of SMEs and dynamic capabilities theory, while showcasing the role of innovation competitive advantage for sustainable growth of SMEs. These results show that the strategic orientation dimensions (of entrepreneurial orientation, market orientation and

resource orientation) can be influenced by innovation competitive advantage for sustainable growth of SMEs. Hence, the data collected support the finding of this study, and uncover the importance of innovation, competitive advantage as a driver of strategic orientation dimensions (entrepreneurial orientation, market orientation and resource orientation) to improve sustainable growth of SMEs.

5.1 Practical Implications

This study offers valuable insights for managerial practice in the SMEs sector. The strategic orientation dimensions of entrepreneurial orientation and market orientation and resource orientation are teamsters of innovation competitive advantage, resulting in higher sustainable growth of SMEs. Understanding the backgrounds of sustainable growth of SMEs will benefit SME managers that engage in a superior level of entrepreneurial orientation, market orientation, and resource orientation processes nurtured through innovation competitive advantage which can improve sustainable growth of SMEs. Therefore, SME managers that promote innovation competitive advantage strategy may gain the benefits that come from building a strong association between entrepreneurial orientation, market orientation, resource orientation and sustainable growth of SMEs. The combination of entrepreneurial orientation and market orientation has a robust influence through innovation competitive advantage on sustainable growth of SMEs. Also, these outcomes show that resource orientation has a strong link with sustainable growth of SMEs. Thus, market orientation is an important impetus for sustainable growth of SMEs. Furthermore, these findings show that innovation competitive advantage positively influence sustainable growth of SMEs. Finally, the findings of this study highlighted the important role of innovation competitive advantage in the setting of the prevailing market competitiveness, where innovation competitive advantage is a key strategic capability and resource that pilot the leading spot in sustainable growth of SMEs. SME Owner and managers need to understand that efficient managing of innovation competitive advantage as the dynamic capabilities is a dominant tool for upholding sustainable growth in SMEs. Furthermore, Society 5.0 encompasses social structure as well as all the Sustainable Development Goals (SDGs), such as sustainable policy, economic growth, the development of new successful models, increased and efficient manufacturing, secure and sophisticated environmental services, reasonable and smart infrastructure use for SMEs' sustainable growth. In Nigeria, where SMEs innovation activities are rated low, these can be fostered through the role of innovation competitive advantage.

5.2 Limitations and Future Research Direction

This study examined the relationship between entrepreneurial orientation, market orientation, resource orientation, innovation competitive advantage and sustainable growth of SMEs. This study only focus on the economic perspective of sustainable growth of SMEs. Future research could provide additional insights by exploring the potentially mediating role of innovation competitive advantage, and explore sustainable growth of SMEs in term of social, economic and environmental factors. Future research should explore the insignificant direct effects of entrepreneurial orientation, market orientation to sustainable growth of SMEs, and as well resource orientation and innovation competitive advantage for large enterprises, multinational look into the

insignificant direct effect between resource orientation and innovation competitive advantage to underscore the cause factors prevented the relationships to be significant. Also investigate into the insignificant affiliation between innovation competitive advantage on resource orientation and sustainable growth of SMEs. Another limiting factor is that the data for this study was obtained in a single manufacturing SMEs in Nigeria, floating the query in generalising of results to enterprises in other sectors and developing countries.

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A Knowledge Base about Non-Pharmaceutical Interventions to Support Hospitals in Responding to Pandemic Situations

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Abstract. The ability to properly respond to a biological disaster such as the Covid-19 pandemic is fostered by making knowledge available quickly and consistently. In absence of a vaccine, knowledge about appropriate actions that prevent the spread of the virus (i.e., non-pharmaceutical interventions - NPIs) becomes essential to save lives. This is especially the case in hospitals, as everyone, including healthcare personnel, is exposed to a high risk of infection. Within this context, decision makers about NPIs in hospitals are constantly under pressure. They have to quickly interpret numerous, lengthy and ever-changing regulatory documents, coming from multiple public authorities for the creation of internal security protocols against the spread of the virus. This is a knowledge intensive task calling for support to ensure an efficient response to a pandemic situation. In this paper, a knowledge base is presented, which consists of an ontology, semantic rules and queries about NPIs. The knowledge base was systematically engineered by considering both (a) official regulatory documents of multiple public authorities and (b) expert knowledge from a Swiss hospital. The ultimate goal of this work is to support decision makers in the creation of consistent security protocols about NPIs. The approach is evaluated via the implemented knowledge base which proves that questions relevant for a decision maker are automatically answered.

Keywords: Emergency Management, Response, Knowledge Base, Decision Making, Non-Pharmaceutical Interventions, Biological Disaster, Covid-19 Pandemic.

1 Introduction

Similar to the influenza pandemic [1] and the SARS-cov-1 epidemic of 2003 [2,3], the COVID-19 pandemic [4] was yet another biological disaster that brought health organizations, especially hospitals, into exceptional emergency situations. Knowledge in such situations is the main determining factor that counts to help reducing losses.
The year 2019 and 2020 have been characterized by a series of cumulative learnings with respect to how to cope with a pandemic situation by governments and organizations. Eventually, these learnings have been crafted into disaster response measures [5], which can be grouped into two main categories: pharmaceutical and non-

pharmaceutical interventions [6]. Non-pharmaceutical interventions (NPIs) include any kind of intervention that is not directly related to the use of medical drugs and vaccines. Among other things, they include preventing and controlling infections from a disease but also contact management such as social distancing and quarantines. NPIs are highly relevant to fight infectious diseases, especially when no effective treatment like a vaccine is available. Hence, public health authorities and the health care systems around the world needed to take quick and consistent decisions on the management of such measures. For example, during the first weeks of the Covid-19 pandemic, managers in hospitals were required to make decisions on personal protective equipment (PPE) policy. However, the initial lack of knowledge in the subject matter, has led to inappropriate advises across countries [7], e.g. using homemade masks, or using mask types like FFP3 that are equipped with an exhalation valve, that don't prevent the spread of pathogens by the wearer, and are there-fore not recommended in the context of the Covid-19 pandemic [8].

The knowledge acquired over time led to new and increasingly appropriate regulation and advice from public health authorities, then adopted by health organizations. However, these instructions come in the form of long official documents also known as regulatory documents. These shall be interpreted by specialized hospital personnel (e.g. COVID-19 taskforce) with the purpose to create internal security protocols.

Hence, a high cognitive effort is required to interpret such regulatory documents, which is time-consuming. The issue becomes even more problematic and error prone when regulatory documents come from different sources. In federal countries like Switzerland, local governmental entities issue more specific and sometimes contradicting regulations. For example, the canton of Basel-City authorized extraordinary exemptions of quarantine only under specific circumstances and for a limited timeframe whereas the Swiss Federal Office of Public Health did not specify such exemptions.

To tackle the proposed problem, this paper presents a knowledge base consisting of machine-interpretable NPIs, aiming to support hospital personnel who need to make decisions on how to apply those as well as to create consistent security protocols.

Section 2 describes the related work around knowledge bases that support decision-making for disaster response. Next, Section 3 presents the adopted methodology. Sections from 4 to 6 explain the scope, design and implementation of the knowledge base, respectively. Section 7 shows the evaluation of the approach through the implemented artifact and finally we discuss the conclusion and outlook in Section 8.

2 Related Work

The dissemination of knowledge during pandemics to inform decision-making was identified as a critical issue that greatly impacts a response to a biological disaster [4, 9-11]. For instance, following the Ebola disease outbreak in 2013, Moon et al. [10] insisted on the critical need to produce and disseminate knowledge and denounce the fact that "reliable systems" for the sharing of knowledge were not established.

Hristidis et al. [12] point to the relevance for businesses to make use of knowledge bases to set in place decision support systems in emergency situations such as disasters.

They also conclude that further improvements “upon the functionalities and/or methodologies of the existing disaster management systems” are required. Their contribution aims at the “facilitation of collaboration between “emergency management officials and private businesses” to reduce the losses caused by crises. Moreover, another key issue identified by Hristidis et al. [12] is making existing knowledge ma-chine-interpretable with the use of semantics (i.e., RDF) to increase the overall quality of query results.

Xu and Zlatanova [13] and Babitski et al. [14] solve the semantic interoperability issues within a disaster response by using knowledge bases with regards to geo-information and resource management, respectively.

The authors in [5, 15-16] exploited knowledge bases to improve the availability of knowledge and support decision-making within disaster responses. Specifically, for biological disasters, the identified critical knowledge covers various domains such as disease surveillance [17-19], personnel management [20-21], use and management of equipment [22], contaminated waste management [23].

In like manner, Farias et al. [24] present an approach for designing a “tool that could integrate multiple information sources” in a healthcare facility, within the con-text of a biological disaster, and that could support decision-making about the man-agement of limited resources. Regarding NPIs, Desvars-Larrive et al. [25] developed a “specific hierarchical coding scheme” for those so as to better monitor the decisions implemented by states and support future emergency management. Differently from them, our work is not limited to a data set, but the knowledge base contains also rules and queries tailored to the need of the decision makers.

This paper builds upon those related works to tackle the domain of the multiple regulatory documents dictating non-pharmaceutical interventions within the Covid-19 pandemic and investigates how a knowledge base covering this domain could support healthcare personnel in their decision-making within a biological disaster response.

3 Research Methodology

The methodology applied for this research work follows the design science research (DSR) [26]. As explained by Van Der Merwe et al. [27], the dual value of applying DSR methodology is that it brings in relevance with the identification of business needs from the research environment (people, organizations and technology) and rigor from the application of “foundations” and “methodologies” from the “knowledge base” available in scientific literature. To add more rigor in the creation of the knowledge base, the DSR phases were supplemented with Noy and McGuinness’s ontology engineering approach [28].

As a result, each DSR phase was instantiated as follows:

In the Awareness of Problem phase, the scope of the knowledge base was defined with a list of competency questions and rules which were written in natural language. The list of the questions and rules were created by expert interviews and documentation analysis. Specifically, three expert interviews were conducted with a manager of the Covid-19 taskforce of Spitex Basel . The first interview followed a semi-structured

approach. The second interview served to create a use case (see Section 7) and to gather related documents. The last interview had the purpose to confirm the acquired knowledge and avoiding misunderstanding.

In the Suggestion phase, the knowledge base was conceptualized. Hence, concepts and relations were derived from the competency questions and rules. It is good engineering practice to identify ontologies of which the concepts can be extended to address the requirements of a new application domain [29,30]. This approach has the convenience of making use of already established semantics, thus of not starting from scratch. Hence, based on the domain requirements framed by the set of competency questions and rules, an existing ontology was identified, and the related concepts were extended accordingly.

In the Development phase, the concepts, relations queries and rules were formalized with W3C standard languages.

In the Evaluation phase, the approach was evaluated by implementing a use case though the formalized knowledge base. For this, functionalities of TopBraid Composer™ were used to show the expected results upon execution of semantic rules and queries against the ontology.

4 Scope of the Knowledge Base

The scope of the knowledge base concerns the support of decision-making in the creation of security protocols. Acting in accordance with current NPIs requires from a hospital to analyze the regulatory documents issued by public health authorities and then to retrieve the knowledge necessary to create its own guidelines, which are transcribed into internal security protocols.

Following the guide of Noy & McGuinness [28], the scope of the knowledge base was captured by defining a list of competency questions and rules written in natural language. While the questions set the scope by framing the specific concepts and relations that shall be retrieved, the rules capture the decision logic and are relevant to keep the knowledge base updated. In fact, rules allow the inferencing of new concepts based on the existing ones.

As mentioned in Section 3, both questions and rules were derived from findings identified with expert interviews and by analyzing regulatory documents and security protocols. What came out was the identification of important issues that should be addressed by the knowledge base. For space reasons, only a small set of competency questions and rules are reported.

First, it should be possible to trace back a given element within the security protocols to the relevant regulatory documents and issuing public health authority. From this, competency questions were defined such as:

1. What regulatory documents does the Federal Office for Public Health dictate? What document regulates the reasons for a close contact quarantine?
2. What quarantine measures are regulated by the document “Instruction on Quarantine for persons arriving in Switzerland”?

Second, an additional finding was that a hospital needed to determine what entity would finance any loss of earnings resulting from the NPIs. For example, while the cantonal office compensates the quarantine of a health employee due to a close contact with a positively tested person, it does not if the quarantine follows a travel to a country with an increased risk of infection. This kind of decision logic was captured in the form of competency rules, e.g.:

1. **If** A health employee is in quarantine **AND** If this health employee's quarantine is a quarantine due to a close contact with a positively tested person **AND** A cantonal office has ordered this health employee's quarantine, **Then** This health employee's quarantine is financed by this cantonal office.
2. **If** A health employee is in quarantine **AND** If this health employee's quarantine is a quarantine because of travelling in a country with an increased risk of infection, **Then** This health employee's quarantine is financed by him/herself.

Another example is about quarantine exemptions:

3. **If** A health employee is in quarantine **AND** If this health employee is tested negative **AND** If this health employee is not symptomatic **AND** A cantonal office has authorized special quarantine exemptions, **Then** This health employee is exempted from following a quarantine to work.

Rules allows the inference of new "explainable" information. Explainability of conclusions was found to be a very important factor for some NPIs. Following on the first example, reasons about who finances a quarantine can be identified by tracing back to the reasons for a quarantine. Regarding the second example, reasons relevant for quarantine exemptions for a health employee can be identified, i.e. negative to the Covid-19 test, no symptoms, and cantonal office authorization. Hence, the questions were framed as follows:

3. Why is the health employee following a quarantine?
4. Why is a health employee exempted from a quarantine?

5 Conceptualization of SPECO

An ontology is a "[…] formal, explicit specification of a shared conceptualization [29]. In our case, an ontology was first conceptualized and then formalized (see Section 6 for the ontology formalism).

As mentioned in Section 3, the list of competency questions and rules was used to select an existing ontology. The main driving criteria for selection were the following: the ontology contains relevant concepts and relations for an enterprise, in particular documentation and organizational aspects. Additional nice-to-have selection criteria were: (a) the ontology is freely available, and (b) extending the ontology has already been proven to be successful in other research works.

The enterprise ontology ArchiMEO [31] was selected as a basis for the design of the new ontology as it matched with all the criteria. ArchiMEO contains relevant concepts

and relations of an enterprise and was successfully extended to address various application domains such as supply risk management, experience management, workplace learning and business process as a service. Additionally, ArchiMEO includes, among other ontologies, the Document and Knowledge Meta Ontology and the Organizational Meta Ontology, which contain document and organizational aspects, respectively. Figure 1 depicts the relations among the considered ontologies and introduces the new ontology as an extension of ArchiMEO.

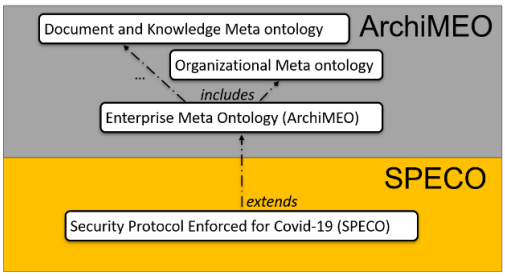

Fig. 1. The new ontology SPECO as an extension of ArchiMEO

The considered classes from ArchiMEO are shown in Section 6. The new classes, related taxonomy, class instances and relations were derived entirely from the competency questions and rules. The new ontology takes the name of SPECO, which stands for "Security Protocol Enforced for Covid-19 Ontology".

A visual representation of an excerpt of SPECO is shown in Fig. **2**. Specifically, classes were defined and refer to the main concepts of SPECO's application domain, including regulatory documents about NPIs for the Covid-19 pandemic (e.g. laws, instructions sheets), involved organizations who interpret these documents, then create and enforce security protocols and the people who follow those. Additionally, the reasons that justify the application of NPIs were also categorized as separate classes.

Properties were assigned to these classes such as the "URL" property indicating where a given regulation document can be found. Similarly, the data-type properties "date of start", "date of end" and "minimum period" were attributed to the classes of "quarantine" and "isolation".

An important aspect modelled into SPECO are the relationships between classes, properties and individual instances. Those take the form of object-type properties. For example, the object type property "finances" relates an instance of the class "Cantonal Office" to an instance of the class "Quarantine". Class instances of every class were created, and the corresponding property values filled. Individual instances of the class "Instruction Sheet" correspond to regulatory documents for Covid-19 like "Instructions on Quarantine" dictated by the Federal Office for Public Health, itself an instance of the class "Federal Office". Similarly, the instance "Law on epidemics" of the class "Law", is a regulatory document dictated by the instance "Federal Council" of the class "Federal Office". It is important to note that not all property values are filled, as some

of those are inferred based on the competency rules defined within SPECO (see Section 7).

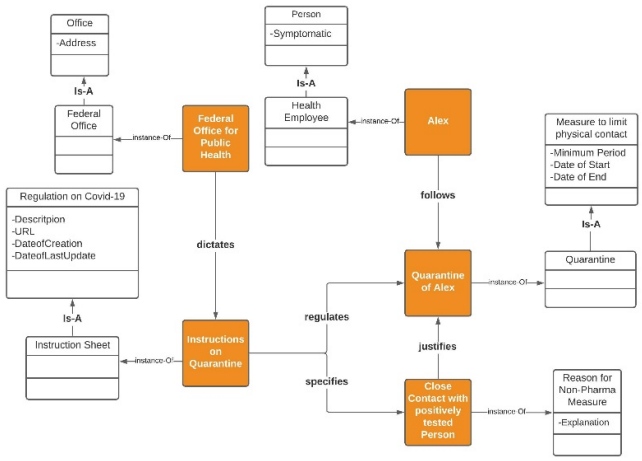

Fig. 2. Object-type and datatype properties, instances and their classes in SPECO

6 Formalization of SPECO

The conceptualized ontology is formalized through the ontology language RDF(S) , which extends the Resource Description Framework Schema (RDF). The competency questions and rules are formalized with the SPARQL Protocol and RDF Query Language (SPARQL). Both standards RDF(S) and SPARQL are maintained by the W3C. For space reasons, this section elaborates only on the formalism of the ontology. Examples for the formalized queries and rules are reported directly in the evaluation section (Section 7) along with the use case.

The decision for the ontology language is in line with the design principle of ArchiMEO [31] where the language expressiveness is chosen according to the purpose of the ontology, i.e. types of facts that are important to deduce, represent and retrieve. Similarly, in our case the purpose is to retrieve facts or to infer new facts about NPIs and not to classify instances automatically. Therefore, the body of knowledge does not need to be constrained with axioms, which would unnecessarily increase the complexity of the ontology. A lightweight ontology language expressed in RDF(S), in contrast to OWL and its sub-languages (e.g. OWL-DL) also has the benefit of a better maintainability. First, it favors a higher simplicity, as it is constraint-free. If constraints are required, they can be added using the Shape Constraints Language (SHACL). Second, it offers a higher degree of agility, as changes can be implement-ed quickly. Namely, if the decision logic changes, only the semantic rules are affected and not the ontology.

In our work this is an important aspect to consider as regulations about NPIs change frequently. Last, it holds the Unique Names Assumption (UNA), meaning that different names refer to different things. This is valuable in our approach as each instance in SPECO (e.g. for persons, institutions or regulations) has a unique identifier.

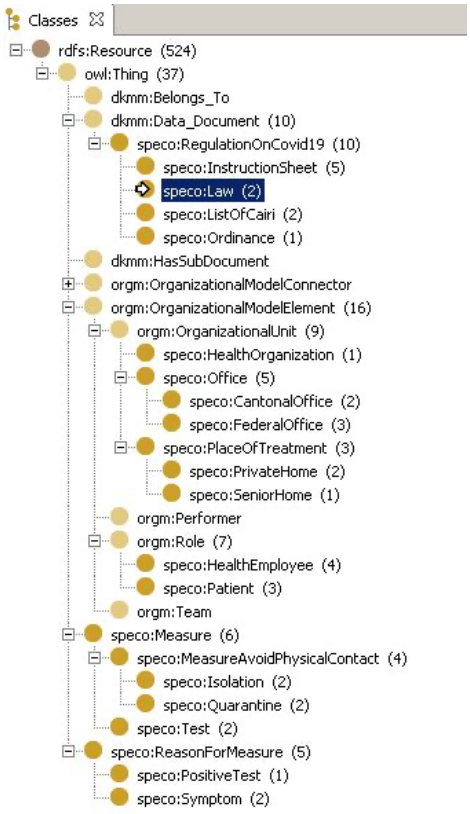

Fig. 3. Overview of the classes in speco.ttl

Following the RDF(S) ontology languages, the pre-defined properties were used to define classes, taxonomy of classes, instances. For example, the class "*Law*" is created by specifying the value for "*rdfs:Class*" as "*speco:Law*", the value for "*rdfs:label*" as "*Law*", and the value for "*rdfs:subClassOf*" as "*speco:RegulationOnCovid19*". The complete taxonomy and related extension from ArchiMEO is depicted in Fig. **3**. Namely, the light-yellow bubbles represent the classes taken from ArchiMEO while those in dark yellow are the newly extended classes for SPECO. Concepts from the Document Knowledge Meta Ontology have the prefix *dkmm* while those from the Organizational Meta Ontology have the prefix *orgm.* Intuitively, concepts from SPECO have the prefix *speco* (see the rightmost tier of concepts in Fig. **3**).

For the specification of attributes and relations, we borrowed the OWL properties: data-type property and object-type property so as to have a better human interpretability between the two. The expressiveness of the language was not compromised as the reasoning capabilities remain the same.

The name specification used to specify both the data-type and object-type properties follow the convention *subjetcPredicateObject*. This convention favors the good understandability about what relationship type is represented by a given property and the two classes it binds. This is notably effective in allowing a better readability by the end user of the knowledge base and also to differentiate between the names of properties and their sub-properties.

For example, the datatype property "*speco:quarantineHasMiminum_Period*", of a class "*speco:Quarantine*" with data type "*Integer*", is formally represented as follows:

```
speco:quarantineHasMinimum_Period
```

```
rdf:type  owl:DatatypeProperty;
rdfs:domain  speco:Quarantine;
rdfs:range  xsd:integer;
rdfs:label  "Minimum Period".
```

Similarly, the object-type "*speco:federalOffice_Dictates_RegulationOnCovid19*" has as domain the class "*FederalOffice*", represents the relationship "dictates" and has as range the class "*RegulationOnCovid19*". Sub-object-type properties were created to specify the range of existing properties. For example, the aforementioned property was further specified with *speco: federalOffice_Dictates_Law*, where the class "*Law*" is a subclass of "*RegulationOnCovid-19*". Fig. ***4*** shows the remaining sub-properties of *speco:federalOffice_Dictates_RegulationOnCovid19* that were implemented in the ontology editor.

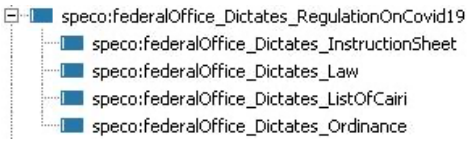

Fig. 4. Object-type property and its sub properties in TopBraid Composer™

Finally, the class instances were formalized too. In Fig. **3**, the numbers in parentheses next to each class name indicate the number of instances. Let's consider the example of "*speco:Federal_Office_Public_Health*", which is an instance of the class "*speco:FederalOffice*". In the domain of SPECO, the federal office for public health dictates four essential documents that are "*Instruction on Quarantine*", "*Instruction on Isolation*", "*Instruction for Testing Ambulatory Sector*" and "*Instruction Quarantine for persons arriving in Switzerland*". Hence, all those documents are instances of the class "*speco:InstructionSheet"* and are resources assigned to the same object-type property: "*federal_Office_Dictates_Instruction_Sheet".* The complete version of SPECO is freely available in a GitHub repository[1].

7 Evaluation of SPECO

This work is evaluated by executing a use case in the created knowledge base. The use case comprises the competency questions and rules that were initially derived. Hence, in line with Noy & McGuinness's suggestion [28], the approach is validated when proving that the knowledge base is able to answer the expected answers.

The use case applied in this research work explores a situation in which the activities of the above-mentioned Swiss hospital Spitex, in the canton of Basel-City, were heavily impacted by the Covid-19 pandemic. This organization dispatches health employees to care for patients at their private homes or in senior homes. Like hospitals, it was of great importance that its employees abide to the non-pharmaceutical interventions set

[1] https://github.com/BPaaSModelling/ArchiMEO

in place by public health authorities, especially considering that a large part of the patients that they care for are over 65 years old, thus having a higher risk of an aggravated Covid-19 infection. Failing to do so could have seriously hurt the organization due to multiple reasons. On the one hand, the reputation of the health organization could have been jeopardized as soon as the care provided by its employees was considered unsafe in the eyes of the patients. On the other hand, the temporary inability to work of employees caused by quarantine and isolation measures lead to financial losses.

Hence, decision-making about the security protocols to enforce quickly became a complex and sensitive issue. The health organization was compelled to gather and interpret the regulatory documents made available by Swiss public health authorities, such as the Federal Office for Public Health. Unfortunately, handling the available information proved challenging. As explained above, because of the dynamic nature of the epidemiological situation, and as the state of knowledge about the Sars-Cov-2 virus evolved regularly, the public health authorities of Switzerland often adapted and tweaked their regulatory documents. Furthermore, relevant information did not come from a single source.

In this context, selected hospital personnel are put in charge of the decision-making about security protocols for this health organization, named Covid-19 task-force. Additionally, a health employee named Alex is working in the same health organization. When Alex is required to go into quarantine, the Covid-19 taskforce should be able to provide clear information about this specific quarantine measure to various stakeholders.

As the Covid-19 taskforce informs and guides all these decisions, it could theoretically make use of the available but long regulatory documents and come up with all the necessary information by itself. However, given the variety of questions asked by the several stakeholders, and the previously mentioned fast-paced evolution of the regulation about NPIs, its task would quickly become overwhelming and therefore prone to errors. The knowledge base SPECO is therefore implemented into the decision-making process to significantly facilitate the job of the Covid-19 taskforce as it enables such reasoning to be done automatically.

For example, SPECO indicates the reason that justifies Alex's quarantine, what regulatory document provides detailed explanations for it, as well as who is responsible for compensating the loss of earnings caused by Alex's temporary inability to work.

Following the example of Alex's quarantine, a demonstration is provided of how such reasoning can be made by SPECO. Let's imagine that the contact tracing ser-vices of the canton of Basel-City have just notified Alex that he has been in close contact with a person that was tested positive for Covid-19 and that he should go into quarantine. The Covid-19 taskforce is going to ask the following questions to SPECO:

1. What document is there that provides detailed explanations about close contact quarantines?
2. Who is going to compensate the loss of earnings caused by Alex's quarantine?

To answer the first question, the following query is executed:

```
SELECT ?subject
```

```
WHERE {?subject speco:regulationOnCovid19_Specifies_ReasonForMeasure
       speco:Close_Contact_With_Positively_Tested_Person . }
```

The query consists in asking SPECO with the function "SELECT" to find any instance for which a given statement in the knowledge base can be made. The function "WHERE" specifies that statement.

As shown in Fig. ***5***, when executed, the query provides the result "*speco:Instruction_Quarantine*" (on the right side). In fact, this instance of the class "*Instruction-Sheet*" is defined within SPECO to be specifying the reason for quarantine "*speco:Close_Contact_With_Positively_Tested_Person*". This test exemplifies how SPECO is able to answer the defined competency question.

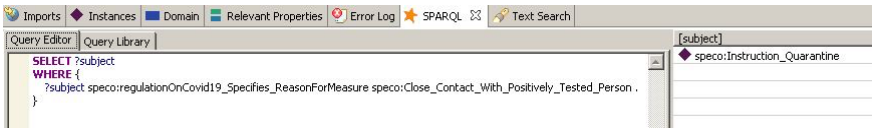

Fig. 5. SPARQL query for the described competency question and result upon execution

Next, the competency rule nr.1 (detailed above) is used to infer automatically the answer to the second question. It is formalized in SPECO as follows:

By using the function "CONSTRUCT", the semantic rule adds the value "*speco:Quarantine_Of_Alex*" to the property "*speco:cantonalOffice_Finances_Measure*". The function "BIND" associates this value to an instance of the class "*speco:CantonalOffice*", if the three conditions (specified also with the function "WHERE") are met.

```
CONSTRUCT {?this speco:cantonalOffice_Finances_Measure speco:Quarantine_Of_Alex }
WHERE {
speco:Alex speco:healthEmployee_Follows_Quarantine speco:Quarantine_Of_Alex .
speco:Close_Contact_With_Positively_Tested_Person speco:reasonForMeasure_Justifies_Measure speco:Quarantine_Of_Alex .
?this speco:cantonalOffice_Orders_Measure speco:Quarantine_Of_Alex .
 BIND (speco:CantonalOffice(speco:Quarantine_Of_Alex) as ?s).
}
```

Fig. 6. SPARQL rule for the competency rule nr.1

As shown in Fig. *7*, once executed, the semantic rule was able to infer that the instance "*speco:Basel_City*" is in charge of financing Alex's quarantine. This test exemplifies how SPECO is able to provide the expected answer to the defined competency rule.

[Subject]	Predicate	Object
speco:Basel_City	speco:cantonalOffice_Finances_Measure	speco:Quarantine_Of_Alex

Fig. 7. Answer provided upon execution of the described competency rule

Additionally, another utility linked to the semantic rule is that the inferred knowledge provided upon execution can be stored into SPECO, thereby keeping the knowledge base updated. This new knowledge can then be utilized for other queries

and rules and is linked to the rest of SPECO's elements. Following the example of Alex's quarantine, the newly inferred information about its financing is asserted into the knowledge base. Technically, the instance "*speco:Quarantine_Of_Alex*" is associated to the instance "*speco:Basel_City*" via the object-type property "*speco:cantonalOffice_Finances_Measure*".

Overall, SPECO has been able to answer the questions asked by the Covid-19 taskforce. This excerpt shows that a proof of concept for the design approach was obtained.

8 Conclusion and Outlook

This paper introduces a knowledge engineering approach for the creation of a knowledge base about non-pharmaceutical interventions (NPIs). The knowledge base aims to support the creation of hospital security protocols which, during the response to a biological disaster such as the COVID-19 pandemic, was observed to be a knowledge intensive task. For this, the new ontology called SPECO was developed rigorously, along with semantic rules and queries. SPECO extends the enterprise ontology ArchiMEO, which provided a wide range of relevant concepts and relations of an enterprise to start from. As of today, the knowledge base counts 942 triples.

The evaluation was conducted by executing a real-world use case on the knowledge base. The use case was conceived from two sources both from Spitex Basel: the hospital's security protocols (documentation) and semi-structured expert interviews. The execution results validated the presented approach. Namely, the knowledge base was able to correctly answer to the competency questions and rules derived from the identification of issues relevant for the hospital's Covid-19 taskforce.

This research is yet a concrete example of how Machine Reasoning approaches are a well-established practice of Artificial Intelligence that shall be taken advantage of for the resolution of problems afflicting Society 5.0 such as pandemic situations.

As a future work, the knowledge base can be extended to answer time- and geographic-related questions, e.g. "Is Canada listed as a country with an increased risk of infection on the 25th of June?". Moreover, to facilitate the maintainability of SPECO also by a non-ontology expert (e.g., adapt or enter new concepts from the regulatory documents) the AI-based modelling environment AOAME [32] can be adopted as it allows the automatic transformation of graphical models into ontologies.

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COVID-19 Contact Tracing Apps

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Abstract. As a response to the COVID-19 pandemic, many countries, including Switzerland, have put enormous efforts to break chains of infections using automated contact tracing apps for smartphones. As a result, different approaches such as centralized and decentralized apps with a wide range of frameworks have been deployed, including DP-3T and PEPP-PT. It immediately raised privacy concerns and intensified the importance of ensuring interoperability between the various apps, especially in border regions. Those frameworks were examined regarding its privacy architecture and interoperability, including usage of the tracing apps of Switzerland, France, and Germany. Applicable regulations such as the GDPR must be complied with, and user concerns and the general effectiveness of automated tracing applications respected. Finally, the conclusion answers the main objectives and provides an outlook with potential solutions.

Keywords: COVID-19, tracing apps, interoperability, regulations, Switzerland

1 Introduction

1.1 Problem Statement & Research Questions

The World Health Organization (WHO) has declared COVID-19 a global pandemic in March 2020. They suggested that contact tracing to be a key component in fighting the global spread of the virus [1]. However, using a manual backtracing approach as a measure is “time consuming, resource demanding, and prone to errors, since people might not remember all their contacts“ [2]. Further, it is stated that digital contact tracing could help detect and interrupt the chain of infections as early as possible.

Regarding following the WHO’s suggestion, Singapore was among the first countries to release its tracing app *TraceTogether* in March 2020 using a centralized approach. Compared to the countries analyzed in this work, Switzerland followed by publishing an official contact tracing app called *SwissCovid* by the end of May 2020. The Swiss app is open-sourced and using a decentralized approach based on DP-3T [3, 4]. The German *Corona-Warn-App* follows a decentralized approach, while the French *TousAntiCovid* chooses a centralized architecture [5, 6]. Besides preserving users’ privacy and tracing apps to be an effective countermeasure against the spread of the COVID pandemic, interoperability between health authorities must be established. The necessity for interoperability has been widely acknowledged and worked on with members from 10 different countries [7].

The main research questions are:

1. Which tracing apps and frameworks are used in Switzerland, France and Germany?
2. To what extend do those tracing apps provide interoperability?
3. Why is the population in these regions reluctant to use tracing apps?

1.2 Limitations

Due to the topic's actuality, most of the literature used throughout this paper could not be peer-reviewed. The authors has put great emphasis on carefully reviewing the integrity and correctness of the sources.

The main focus was analyzing frameworks directly correlating to the COVID-19 app of Switzerland, Germany, and France to describe the centralized and decentralized app tracing approach. There are numerous other frameworks used in different regions, but not described in detail. Regarding restrictions and limitations, this paper focuses predominantly on technical limitations because the author could not find substantial evidence of political reasons for separating contact tracing app development across countries.

2 Methodology

To establish the basis to answer the paper's objectives, existing frameworks had to be researched using databases such as Google Scholar and arXiv. For this purpose, the following keywords were used in different combinations: "covid", "tracing apps", "centralized", "decentralized", "DP-3T", "PEPP-PT", "Switzerland", "Europe", "Germany", "France". Additionally, along with examining the qualitative findings of various authors, the respective white papers of the frameworks were studied in depth. They were published publicly accessible at GitHub and GitLab.

To describe the tracing apps of Switzerland, France, and Germany, their correlating official websites published by the public health authorities were taken as a basis to analyze additional information being referenced. Moreover, public press releases from the countries, including the European Union, were collected and reviewed.

Regarding investigations of the frameworks' and apps' interoperability towards each other, Google searches and reviewing newspaper articles were used to accumulate hints of evidence. Each source assessed to be potentially valuable was traced back to its origin to verify its validity. The quality of information enormously varied across Switzerland, Germany, France, and the European Commission. Hence, the information found was only used when all doubts could be excluded.

Common user concerns towards tracing apps were extensively described in the papers found but were merely proven by conducted surveys. Therefore, appropriate surveys were assessed to underline the concern's meaningfulness where possible. Unfortunately, only a few surveys have been conducted to date.

3 Technical aspect of tracing apps

To analyze Switzerland's potential for interoperability with its border regions, this section describes proximity tracing frameworks. Section 3.1 gives an overview of available frameworks and describes the centralized resp. the decentralized approach with the examples of PEPP-PT, DP-3T, and Apple-Google's Exposure Notifications. Section 3.2. deals with the effective implementation of tracing apps in Switzerland and its border countries France and Germany.

3.1 Proximity tracing frameworks

On the question of technology-based proximity tracing, various initiatives appeared. Their common goal is to detect chains of infections by tracking proximity while preserving user privacy, mainly classified into three types: decentralized, centralized, and hybrid. [2] listed the currently used frameworks in Table 1, differentiating them by type of approach, whether the source code is open-sourced, health authorities involved, and location data collected.

Table 1: Main characteristics of contact tracing frameworks [2]

Framework	Approach	Source Code	Health authority	Location data collected
DP-3T	Decentralized	Open	Yes	No
Google/Apple	Decentralized	Proprietary	Yes	No
PEPP-PT NTK	Centralized	Open	Yes	No
ROBERT	Centralized	Open	Yes	No
BlueTrace	Centralized	Open	Yes	No
TraceSecure	Centralized	Not available	Yes	No
DESIRE	Hybrid	Not available	Yes	No
PACT (UW)	Decentralized	Open	Yes	No
PACT (MIT)	Decentralized	Not available	Yes	Optional
TCN	Decentralized	Open	Optional	No
OpenCovidTrace	Decentralized	Open	Yes	Yes
Whisper Tracing	Decentralized	Not available	No	Optional

Centralized. Both decentralized and centralized approaches have multiple implementations. To explain the mechanisms of centralized frameworks, PEPP-PT was elected as a reference because it finds use in the French tracing app *TousAntiCovid,* which will be explained in more detail in section 3.2.

According to [2], key components of PEPP-PT are the users' smartphone having the app installed, a centralized backend server generating temporal IDs and receiving encounter messages, as well as a Push Notification Service that informs the user's locally installed apps to pull new information from the backend server. Similar to the decentralized approach, it requires Bluetooth and Push Notifications to be enabled for this approach to work. The interactions are divided into four steps: User registration, proximity tracing, infection notifications, and federation across other backends in Europe.

User registration. To prevent the mass creation of user accounts, the user must register his app instance to the backend server. The registration involves a combination of proof-of-work (PoW) and a Captcha, which prevents denial-of-service (DoS) and mass registrations. When the user requests to register with the backend, those two challenges are sent to the app. The app will solve the PoW challenge itself, while the Captcha must be solved by the user. Both results will be returned to the backend server, which – provided that it is valid – answers with OAuth2 client credentials, consisting of a random *client_id* and a random *client_secret* over a TLS-secured network. Those short-lived credentials are used for every subsequent request to the backend server and allow inference to a "128-bit unique random pseudonym of the user" called PUID. This PUID is generated and stored on the backend server, along with the user's push notification ID [8].

Proximity Tracing. The backend server regularly generates global secret keys BK_t (whereas t refers to the short timeframe validity of, e.g., one hour) along with *Ephemeral Bluetooth IDs* (EBID) for each user AES-encrypted using the BK and their PUID separately. Because the EBID depends on the short-lived BK, the app can request multiple EBIDs from the backend server for a more extended period (e.g., two days). Starting from this point, the app begins to broadcast its contemporarily valid EBID via *Bluetooth Low Energy* (BLE) advertisements using BLE privacy feature, which enables the exchange of temporary addresses – *Resolvable Private Addresses* (RPK) – instead of fixed hardware addresses (MAC). This prevents backtracing the user's physical device. Consequently, only the backend server can determine the user's identity [8].

The users' app constantly scans other PEPP-PT apps and records all EBIDs received, the current time, and the connection's metadata. Metadata include the received signal strength (RSSI) and the signal power (TX/RX), which is used to estimate the duration and distance of contact between two users. The PEPP-PT architecture refers to this data as Contact/Time data (CTD) and will be deleted from the users' phone after the epidemiological relevant time (e.g., defined as 21 days) after receiving and thus, occurred contact [8].

Infection Notifications. When a user is diagnosed as COVID-19 positive, the collected CTD is uploaded to the backend (which is held up to three weeks) to evaluate which users are called "at-risk" contacts and shall be notified. To secure the data upload and ensure integrity, the user is provided with a *Transaction Authentication Number* (TAN) from the health authority, which needs to be uploaded along with the data. The CTD contains all recorded EBIDs and timestamps (t) that the server decrypts using the BK_t of the given time recorded. Affected PUIDs will receive a push notification, along with many randomly selected other PUIDs to avoid inference (called noise messages). The receiving apps use this notification to trigger a synchronization request to the backend server asking for the users' risk. In case of being at risk, the user receives instructions on how to proceed [8].

Federation across Europe. Subject to the functional requirements of the PEPP-PT system, the federation across different countries and backend systems in Europe must be supported. Each country has the possibility to run its own backend and retain sovereignty over the data. This includes the decision on how EBIDs are constructed and how risk analysis is done [8].

For this purpose, the backend system must be able to determine the origin of the encountered EBIDs. An encrypted country code (ECC) as the first byte of an issued EBID guarantees that only the issuing backend can translate it back to the respective PUID. Consequently, EBIDs containing a foreign ECC must be forwarded to its "home backend" for risk analysis and user notification [8].

Decentralized. Decentralized proximity tracing frameworks differ from centralized approaches in that the core functionalities remain within the client app installed by the user. [9] emphasized that its main idea is to leave the backend server with minimal involvement and strengthen the user's privacy.

According to [2], the decentralized approach only requires a backend server and the mobile app installed on the users' smartphone. He defines the two main processes as generating and storing ephemeral IDs (EphIDs) and proximity tracing. However, the DP-3T whitepaper divides the process into setup, creating ephemeral IDs, local storage of observed EphIDs and secret day seed (SK), and decentralized proximity tracing [10].

Generation and storing. Unlike centralized approaches, the user must not register his device. The app generates an initial secret day seed SK_t (where t represents the current day) and encrypts it using a cryptographic hash function. This SK is rotated each day depending on the previous secret seed by computing $SK_t = H(SK_{t-1})$, which, in case of a key being compromised, does not reveal every SK prior to it. Each day, the smartphone generates a list of EphIDs depending on the current SK. The app stores these EphIDs along with exposure measurement data (e.g., signal attenuation) and the timestamp and randomly broadcasts it using Bluetooth Low Energy (BLE) advertisements. Furthermore, the SKs are locally stored for a period of 14 days [10].

Proximity tracing. When a user is diagnosed as COVID-19 positive, the health authority provides a code to the user which will be used to instruct the app to upload his seed SK_t, whereas t is the day the user is considered contagious. After the seed SK_t has been reported, the app deletes it and generates an entirely new one, therefore broadcasting newly derived EphIDs going onward. Registered users pull the collected positive pairs (SK_t and t) regularly from the backend server and check their locally stored EphIDs for existing entries. If there is a matching entry, the coherent exposure measurement data is passed for local exposure risk computation. In case of the calculated exposure score being above the threshold defined by the health authority, a local notification is shown to the user with the information of being potentially exposed to the virus along with additional information about how to proceed [10].

This process describes the "low-cost decentralized proximity tracing" design. However, the DP-3T white paper proposes two additional approaches: unlinkable decentralized proximity tracing and hybrid decentralized proximity tracing. The latter works similarly to Apple's and Google's Exposure Notification.

Exposure Notifications. On April 11, 2020, Apple and Google announced a joint effort to develop a Bluetooth-based contact tracing system. They intended to provide a solution for interoperability of tracing apps across mobile operating systems and countries if they actively choose to opt-in [11].

As described in the section above, the Exposure Notifications API (ENA) works similarly to the "hybrid decentralized proximity tracing" approach proposed by the DP-3T white paper [10]. However, unlike DP-3T and PEPP-PT, ENA is implemented at the operating system's level, providing a framework API to enable health authorities to implement it in their contact tracing apps.

When the user grants permissions to enable ENA, a temporary exposure key is generated to derive the encrypted Rolling Proximity Identifier (RPI). To prevent linkability, the RPI is rotated when the BLE advertiser address changes (random interval between 10 and 20 minutes). The RPI is broadcasted along with associated encrypted metadata (AEM), which contains protocol versioning and transmit power for risk analysis [2, 12].

Because the Exposure Notification System is built into the smartphone's operating system, vendor requirements need to be considered. For apple smartphones, ENA support was added to iOS at version 13.5 [13]. Starting with version 13.7, the Exposure Notification System can be enabled without the need to download a specific app. Since this excludes older iPhones (e.g., iPhone 6) to make use of ENA-based tracing apps, Apple has announced an update to iOS 12.5 [14]. For Android smartphones, Google has added support for Exposure Notifications for Android version 6 and above. However, version 10 and earlier needs the phone's location setting to be turned on, even though it does not use location data [15].

On May 25, 2020, Switzerland implemented ENA on a *SwissCovid* pilot app [16].

3.2 Tracing Apps of Switzerland and its border regions

Switzerland. *SwissCovid* is the official contact tracing app of Switzerland. It was developed by FOITT, ETH, and EPFL and is operated by the Federal Office of Public Health (FOPH). *SwissCovid* uses a decentralized approach based on DP-3T and Exposure Notifications API. Its base source code is open-sourced at GitHub [3, 4].

Statistics published by the Federal Statistical Office [17], known as FSO, recorded 2.84 million app downloads while considering only 1.82 million installations being active (64.2%). The FSO [18] declares this survey to be based on automated configuration requests (every 6 hours after activation of the app), counting the number of requests for 24 hours and then dividing by 4.

A *SwissCovid* analysis of Vaudenay & Vuagnoux [19] observed that the app's core functionality is not open-sourced (referring to ENA) and, thus, outside of the control of the Swiss health authority. Additionally, SwissCovid requires users to consent to send personal information to Apple and Google, whereas the app itself is not allowed to collect such information [19, 20]. The FOPH does not mention ENA to be a component of the *SwissCovid* app. The DP-3T repository confirms the use of ENA but does not contain the actual source code of the app [3, 19].

France. *StopCovid* was the first COVID-19 contact tracing app in France, released on June 2, 2020 [21]. On October 22, 2020, the second app *TousAntiCovid* was released and served as an update, according to an article of The Connexion France [22]. The

article further implies that relaunching the app was due to the missing traction of the former app. Many other newspapers, including Le Monde [23, 24], claimed that a new application was necessary as the former could not stand a significant number of concurrent requests. However, the official website of *TousAntiCovid* [5] does not justify the renewal of the app beyond doubt, e.g., added, updated, or removed core functionality. Instead, it announces *TousAntiCovid* as a mainly visually "enriched" version of the first *StopCovid* app.

TousAntiCovid, like its predecessor, uses a centralized contact tracing approach using the ROBERT[1] protocol – a candidate proposal for the PEPP-PT initiative [8, 25]. This protocol differs from PEPP-PT only in that it uses a pure polling-based approach to avoid the necessity of push notification services. Therefore, the app needs to ask (poll) for updates instead of retrieving them asynchronously (push). The ROBERT schema refers to it as *Exposure Status Requests* and occurs at least once per 15 minutes. This is a possible explanation as to why the central server could not handle the request load.

In contrast to the Swiss and German apps, *TousAntiCovid* is not using Exposure Notification. The health department argues that it does not comply with their choices made in terms of architecture [5]. An analysis of Cunche et al. [26] concludes that a drawback of using ENA is an increased "feasibility of a number of privacy attacks, exposing users declared infected to serious privacy threats".

According to metrics published by Etalab [27], the new *TousAntiCovid* app has been downloaded 5.86 million times, which cumulates to 8.56 million across both app versions. However, those numbers describe the downloads and activations (minus deregistrations) but do not include the number of effectively active users.

Germany. *Corona-Warn-App*, Germany's COVID-19 tracing app, was released on June 16, 2020 [28]. The official website [29] states that it was developed by Deutsche Telekom and SAP and was published by the Robert Koch Institute (RKI).

It is open-sourced at GitHub and based on Exposure Notification, inspired by the TCN[2] and DP-3T protocols [30]. According to [31], Germany decided to switch from a centralized PEPP-PT to a decentralized approach using Exposure Notification following the DP-3T protocol. This decision was made to meet data protection standards and to enable interoperability with other apps based on ENA.

According to statistics published by RKI [32], the app has been downloaded 23.8 million times across Android and iOS smartphones and has reported 115,426 positive test results as of December 9, 2020. However, this report does not include information about the number of active installations.

[1] ROBERT stands for "ROBust and privacy-presERving proximity Tracing protocol".
[2] TCN stands for "Temporary Contact Numbers".

4 Interoperability of tracing apps

Because the spread of the virus does not stop at borders, the deployed apps from different countries should be able to interoperate with each other – especially for people living in border areas. However, according to [7], seamless interoperability is challenging because of different frameworks being used and regionally varying administrative boundaries. Users should not be required to install multiple apps for each region. Therefore, a wide range of deployment types must be supported, which Rosa et al. distinguished between: Single official deployment, concurrent deployment and aggregation-oriented deployment.

This section examines the interoperability of the Swiss, the German, and the French tracing apps. Section 4.1 focuses on technical requirements, and section 4.2 describes the European Federation Gateway.

4.1 Technical requirements

Rosa [7] as well as the European Commission agreed on technical specifications for interoperability with the primary requirement of using a decentralized approach. The Commission additionally assumes participating operators to rely on ENA [33]. Therefore interoperability requires the apps to:

- detect and collect Bluetooth beacons of users with different apps and decentralized tracing protocols,
- compute exposure risk analysis on encounter data regardless of the region it has been collected or health authorities being responsible,
- share data of positively diagnosed patients to the relevant users being at risk regardless of their active regions.

The proposal focused on the decentralized protocols DP-3T, PACT, TCN, and those relying on Exposure Notification. It describes a mechanism to handle the home region (active region) and the roaming regions (when traveling). It requires the operator of the app to provide the user with a list of compatible regions, which the user must maintain manually[3]. However, risk analysis in roaming regions will only be computed during the visit.

Enabling interoperability for centralized approaches such as PEPP-PT or ROBERT would be technically possible but severely weakens the users' privacy of decentralized systems [7]. Therefore, the European Commission [33] unambiguously requires operating tracing apps using a decentralized approach and relying on Exposure Notification. Thus, countries not using EAN are considered incompatible.

As examined in section 3.2, Switzerland and Germany are principally compatible to interoperate, which is also confirmed on the official website of the *SwissCovid* app [4].

[3] Technically, automated roaming regions management would be possible but requires sensitive location information.

However, France is considered incompatible according to a list of apps from the European Commission because of its centralized approach [34]. This list (see Table 2) confirms 9 apps to be interoperable already. Most notably, the only countries being declared not even "potentially interoperable" includes France and Hungary solely.

Table 2: Mobile contact tracing apps in EU member states [34]

Country	Tracing app	Already interoperable	Potentially interoperable
Croatia	Stop COVID-19	Yes	Yes
Denmark	Smittestop	Yes	Yes
Germany	Corona-Warn-App	Yes	Yes
Ireland	COVID Tracker	Yes	Yes
Italy	Immuni	Yes	Yes
Latvia	Apturi Covid	Yes	Yes
Netherlands	CoronaMelder	Yes	Yes
Poland	ProteGO Safe	Yes	Yes
Spain	Radar Covid	Yes	Yes
France	TousAntiCovid	No	No
Hungary	VirusRadar	No	No

4.2 European Federation Gateway

On June 16, 2020, the European Commission announced in a press release that member states had agreed on technical specifications to provide "safe exchange of information between national contact tracing apps based on a decentralized architecture" [35]. This enables European countries to safely exchange the encounter information presumed they follow a decentralized approach and making use of Exposure Notification API.

To enable apps to share proximity and encounter information, the Commission had set up a single European Federation Gateway Service, known as EFGS, which went live on September 28, 2020 [33, 35, 36]. The EFGS enables backend-to-backend communication across all participating nations. On October 19, 2020, the European Commission [37] confirmed in a press release that the apps of Germany, Ireland, and Italy had been linked to this gateway service. Furthermore, the Commission stated that 20 apps in total could be interoperable.

To date, in addition to the countries joined previously mentioned, the following countries are registered with the EFGS: The Republic of Latvia, Spain, Denmark, Croatia, Poland, The Netherlands, and Cyprus [37, 38].

5 The use of tracing apps

5.1 Regulations

Applications operated in Europe are subject to the regulations of the General Data Protection Regulation (GDPR). The GDPR dictates rules that also apply to the storing, processing, and sharing of personal data in the context of such apps. To not hinder taking measures to mitigate the COVID-19 pandemic, the European Data Protection Board [39] has released a statement that confirms to allow competent health authorities

the processing of personal data in the context of the pandemic. However, applicable rules of the GDPR regarding data processing must be complied with (GDPR Art. 5).

Integration of Switzerland to the EFGS. The integration of Switzerland to the European Federation Gateway Service (EFGS) fails due to the lack of a bilateral health agreement, according to [40]. The finalization of a health agreement is a prerequisite for participation but continues to depend on the institutional framework agreement, Hess says. Instead, von der Leyen suggests that the tracing apps' interoperability could be provided in the short term through bilateral agreements between individual EU member states and Switzerland. However, this would require Switzerland to negotiate agreements with 27 member states [40].

5.2 User Concerns

According to [9], users' primary concern towards using automated app-based contact tracing includes battery usage, compatibility across operating systems and apps, consent withdrawal, and transparency. Each of those concerns will be examined in conjunction with a survey of [41] among 8088 respondents of the Republic of Ireland (where possible).

Battery usage: Most of the tracing apps make use of Bluetooth technology. In fact, the apps of Switzerland, Germany, and France use BLE to broadcast encounter messages. According to Ahmet et al., battery usage depends on the implementation of the app and the communication with the backend server. [41] observed that 55% of respondents believe that using Bluetooth adversely affects their device's battery life. However, 63% use Bluetooth for other applications "every day" or "most days".

Table 3: Comparison of factors affecting device battery usage [9]

Arch	Encounter exchange	Downloads	Data upload	Processing at device
Centralized	BLE periodic exchange of short messages (TempIDs)	Periodic download of TempIDs (once in 15 minutes)	Upload all encounter messages for the past 21 days	Minimal
Decentralized	BLE periodic exchange of short messages (Chirps)	Download of seeds for positive cases (once in 24 hours)	Upload seeds used for the past 21 days	High. Device periodically generates seeds/chirps

Comparing the information exchange and Bluetooth usage of centralized and decentralized approaches, Ahmet [9] show that both exchanges encounter messages and similarly upload data to the backend server. However, decentralized apps only download seeds for positive cases once every 24 hours, whereas centralized apps download TempIDs once every 15 minutes. In contrast to this, the centralized architecture requires only minimal local processing because risk analysis is computed server-side.

Compatibility across operating systems and apps. In the survey of [41], the participants responded to the reason for installing tracing apps including, but not limited to: Protection of family and friends (79%), responsibility to the wider community (78%),

and self-protection (65%). Because many smartphone operating systems are in use and many different devices, providing compatibility and interoperability must be considered a critical requirement.

Consent withdrawal. Consent withdrawal refers to the ability of the users to stop sharing their data. Article 7 of the GDPR requires the right to withdraw the users' consent at any time. This includes the deletion of collected and processed data, such as collected within the data collection phase and the data uploaded to the server. Among the Irish survey participants, 41% are worried about possible technology company surveillance after the pandemic, and 33% of respondents fear the government would use these apps as an instrument for greater surveillance after the pandemic [41].

Regarding user privacy and security, Apple's Exposure Notification FAQ [42] states that each user must explicitly opt-in to enable it. Moreover, Google and Apple stated to disable ENA when it is no longer needed automatically.

Transparency. According to [9], there is public concern regarding the methods of the information being collected. Referring to the previous paragraph examining the fear of surveillance, Ahmet et al. further state that trust is another critical factor in user adoption.

[41] reported that 58% of respondents are definitely willing to install tracing apps, while only 6% denied it. Similarly, a multi-country study conducted by [43] with 5995 participants revealed the willingness to download such apps at 75%. Furthermore, 68% said they would probably or definitely keep the app installed, presumed they are able to opt-out (consent withdrawal).

On May 25, 2020, the FOPH [44] published a survey conducted with 2819 participants in Switzerland. 59% of respondents had agreed to install the SwissCovid app either definitely or "more likely". Additionally, reasons given against the installation included the following: insufficient data security (47%), fear of surveillance (29%), and extensive battery usage (19%).

5.3 Effectiveness

A study from Oxford University assessed it would take 80% of all smartphone users to use contact tracing apps to end the Covid-19 pandemic, or 56% of the world's population [45]. However, even lower adoption rates would still result in positive effects when combined with manual tracing, testing, and quarantine measures [46].

According to [47], the population's adoption of the contact tracing app remains the bottleneck. Predicting the apps' impact is difficult because it depends on factors such as the general penetration rate of digital solutions in society, compatibility across operating systems and concerns regarding privacy and security. [47] agree that tracing apps on a voluntary basis appears preferable, although a study shows that 68% of respondents would keep automatically installed apps [43].

[47] identifies "public trust" as a key dependency for the uptake of automated contact tracing but concludes with a list of extending factors to consider including establishing public health measures and infrastructure, limiting the number of apps available, and considering risk for privacy.

6 Discussion

Since the pandemic outbreak, a vast number of approaches, frameworks, and tracing apps have appeared. Undoubtedly, it became difficult to keep an overview of the tracing apps being in use. However, it could be determined that Switzerland and Germany both use Apple/Google Exposure Notification following the DP-3T suggested decentralized approach. France was identified to keep relying on a centralized approach even on their second attempt releasing a tracing app.

Nevertheless, with the introduction of the European Federal Gateway Service, the European Commission enabled countries participating using a decentralized approach along with ENA to communicate across country borders. Although this gateway would generally be compatible with centralized backends, it remains unclear if France is able or even willing to join. Given that Switzerland and Germany use an approach that is collecting encounter information on an operating system's level, they have ensured interoperability, especially for their inhabitants at border regions. Thus, users would only be required to enable ENA on their smartphones operating system settings.

Prevalent user concerns towards consenting to the use of tracing apps remain existent. In fact, the genuine reason for reluctance was proven to be the lack of trust in their governments, health authorities, and technology providers. The vast majority of respondents fear mass surveillance while the pandemic prevails, resp. thereafter. Indeed, centralized apps as France's *TousAntiCovid* holds huge potential regarding abuse by operating authorities.

Assuming most of the users do not have the required technical knowledge to either fully understand or evaluate the technology used, governments will not be able to increase public trust. Measures, as taken from the European Commission, such as aligning technical specifications as well as establishing a public gateway, should be taken globally. Exemplary, the World Health Organization's official website does not contain clearly visible information about tracing apps' deployment. Fortunately, the Swiss, German as well as the French health ministries provide sufficient information to their respective apps. However, putting this information together to a coherent overview is not even trivial for academic researchers.

7 Conclusion

The authors focused on examining the proximity tracing frameworks used in Switzerland, Germany, and France. The decentralized DP-3T and the centralized PEPP-PT approach were analyzed. Additionally, Google and Apple's joined effort building a cross-platform tracing framework Exposure Notification was identified as a potential solution to provide interoperability while preserving privacy across operating systems, devices, and apps. Consequently, the European Commission has enabled EU member states, which are making use of ENA, to communicate across country borders. However, sharing personally identifiable data falls within the legislation of the GDPR. Unfortunately, missing bilateral agreements with the European Union excludes Switzerland to partic-

ipate with the EFGS. Apart from this, user concerns regarding battery impacts, compatibility, and data security continue to play a crucial role in the population's aversive attitude toward tracing apps. Moreover, pandemic containment's effectiveness is not based exclusively on an automated app but a combination of different measures.

To answer the research questions defined in section 1.1. we examined that Switzerland and Germany both use a combination of DP-3T and Exposure Notification. France, however, uses a centralized approach based on ROBERT. Therefore, the Swiss and the German app are technically interoperable, but because Switzerland is not able to join the EFGS due to the lack of appropriate bilateral agreements, the user is required to switch his region manually when crossing borders. However, the French app is incompatible with both. The users' main reasons against the use of tracing apps include battery usage concerns, incompatibility, intransparency, and the fear of surveillance during and after the pandemic. Furthermore, the app's effectiveness depends on additionally taken actions.

While this research revealed the interoperability of the Swiss, German, and French apps, as well as the reasons for user's reluctance, the need for further surveys and investigations remains. Conducting them would help improve the understanding of why the tracing app's adoption stays below the level to support the pandemic's containment effectively.

One year after the pandemic outbreak, politicians now urge to a unified solution. According to an NZZ article [48], Switzerland should be able to join the EFGS before Easter 2021. It remains uncertain if France will be able to join the EFGS.

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Moving Towards Society 5.0: A Bibliometric and Visualization Analysis

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Abstract. This paper aims to provide a holistic approach for a brief understanding of the current state of literature of Society 5.0 by deciphering its characteristics, subjects, the geographical distribution of publications, keywords and general concepts by using bibliometric data retrieved from the Scopus database. We used descriptive analysis to examine publication characteristics, subjects and geographical distribution of published documents, Harzing's Publish or Perish to calculate citation metric and VOSviewer version 1.6.16 for data and network visualization. Through the network analyses of author and index keyword co-occurrences, research clusters were revealed from different perspectives. The bibliometric analysis indicates that Society 5.0 is heavily influenced by the advancement of the Industrial Revolution (IR) 4.0. The intellectual structure of the Society 5.0 literature is being dominated by engineering-related fields, artificial intelligence (AI), and the Internet of Things (IoT). Our analysis revealed the existence of a strong link in the temporal co-map between Sustainable Development Goals (SDGs) and Society 5.0. This paper also emphasizes on university's role as an important stakeholder in Society 5.0 ecosystem.

Keywords: Bibliometric study, SCOPUS, Society 5.0, emerging research topics

1 Introduction

The concept of Society 5.0 or also known as "super-smart society" was first introduced by the government of Japan in April 2016. The analysis outcome of the joint research report "The Evolution of ESG Investment, Realization of Society 5.0, and Achievement of SDGs" by Keidanren, the University of Tokyo, and the GPIF (Government Pension Investment Fund) (2020) quoted "*Society 5.0 is a sustainable, human-centered society in which the physical and cyber worlds are highly integrated by digital transformation, no one is left behind, and everyone works together to create safe and comfortable lives and new growth opportunities*" [1]. The IR 4.0 promotes digitalization and autonomous systems by using technologies such as the Internet of Things (IoT) and Artificial Intelligence (AI). These technologies operate the decision-

making mechanisms that link human command to machines and electronic systems. However, the concept of IR 4.0 lacks human factors. A Japanese originated philosophy of Society 5.0 integrates the Industry 4.0 technologies to create systems that harmoniously served the interest of society [2]. By combining cyberspace and physical space, Society 5.0 aims to leverage the digital transformation of IR 4.0 to create balance economic advancement to alleviate social problems through the provision of products and services.

This paper highlights the current state of the art of Society 5.0 literature corpus. The bibliometric review offers various advantages in term of examining the research domain from the perspective of a bird's eye view. Bibliographic analysis assists a researcher to understand the state of the art in the research area and means to justify the position of the research work concerning the existing studies. Besides, a researcher is also able to extract the emerging trends in the research area and determine the evolution of research topics [3]. Due to a vast number of academic publications, the bibliometric analysis offers a quantitative approach to analysing a vast number of published peer-reviewed documents effectively. The emergence of the Society 5.0 concept emphasizes the importance of multidisciplinary research and requires researchers with different expertise to collaborate harmoniously under one research team. Even though this research domain is still practically very new, it is crucial to examine how far it has been developed. Therefore, this bibliometric review addressed the following research questions.

1. What are the volume, research subject area, and geographic distribution of scholarship on Society 5.0?
2. What is the intellectual structure of the Society 5.0 knowledge base?

2 Methodology

In this study, we used the Scopus index database to search and extract documents. The reason for choosing Scopus as it covers comprehensive publications of reputable sources. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guideline was adopted for this review (**Fig. 1**).

As of 6th March 2021, we managed to retrieve 142 documents published by entering the search query string of TITLE-ABS-KEY ("Society 5.0") into the Scopus search engine. These 142 documents were subjected to analysis. For the Scopus search, we did not specify any start date. Based on retrieved literature from the Scopus database, the earliest documents were published in 2017. To answer the first research question, we used descriptive statistics to analyse publication characteristics and geography of the Society 5.0 literature. The citation metric and frequencies were calculated by using Harzing's Publish or Perish. We answered the second research question by using Visualization of Similarities (VOS) viewer version 1.6.16 software (https://www.vosviewer.com/) for visualization of bibliometric maps and cluster determination in the Society 5.0 literature [4].

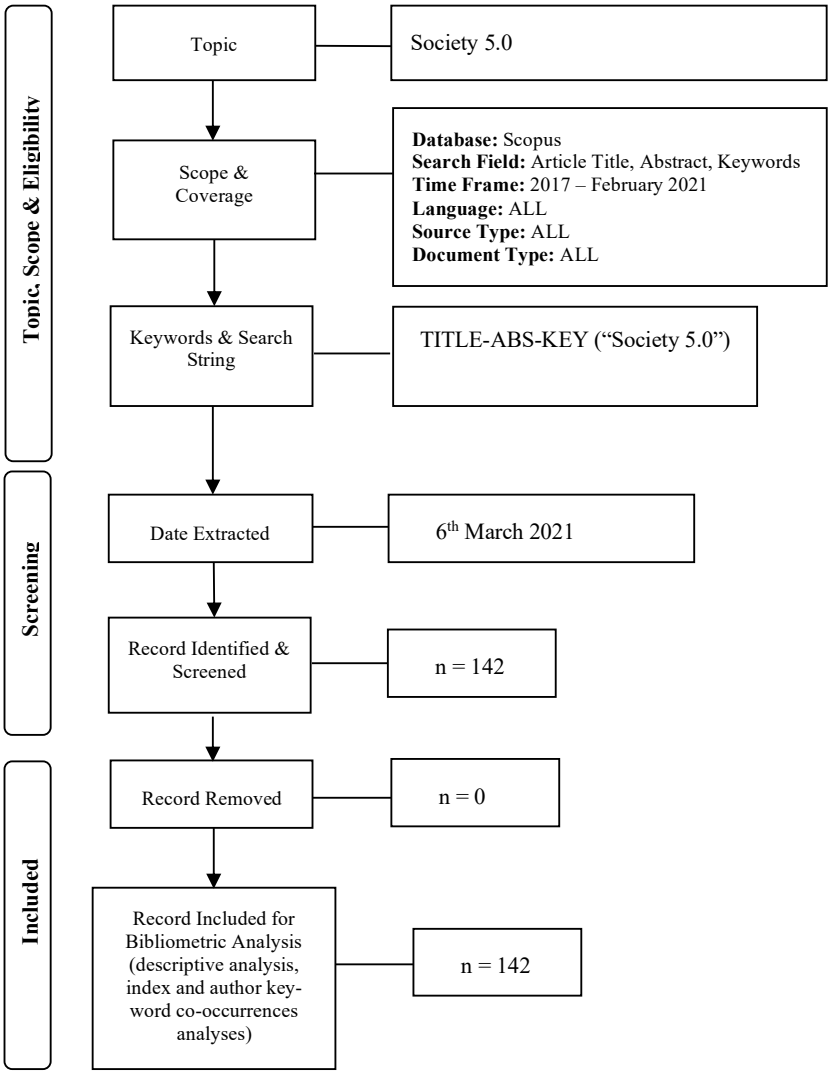

Fig. 1. PRISMA flow charts of procedures used in the identification of sources for the Society 5.0 bibliometric review

3 Findings

In this section, we present the results for the various bibliometric indicators such as the description of the retrieved literature, research subject areas, geographical distribution of publications and leading institutions, as well as key authors and intellectual structure of Society 5.0 knowledge base.

3.1 Description of retrieved literature

The 142 Scopus-index documents published within four years represent the current intellectual structure of Society 5.0. Based on these results, we justified that Society 5.0 is a newly established field as the first paper was published in 2017. **Fig. 2** shows the number of published documents from 2017 to February 2021, showing a steady increase in numbers. This analysis also revealed various document types which include original article (40.85%), conference paper (38.03%), book chapter (10.56%), conference review (3.52%), review (2.82%), and other types of documents that contributed less than 2% of the total publication. The highest number of documents were published in journals (63, 44.37%), followed by conference proceedings (47, 33.10%), book series (19, 13.38%), book (10, 7.04%), and trade journals (3, 2.11%). The majority of the retrieved documents were published in English (131, 92.25%), followed by Japanese (7, 4.93%). Other languages include Portuguese, Romanian, Russian, and Turkish that each only contributed to less than 1% of the total retrieved documents. This shows the role of English as the main language to disseminate knowledge on Society 5.0 among the international research community.

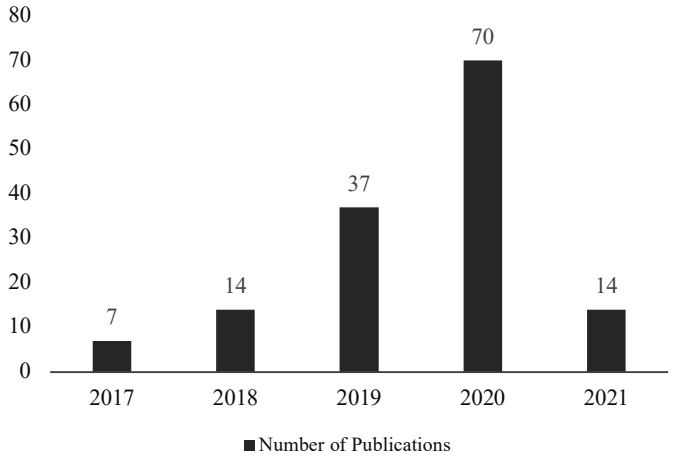

Fig. 2. Number of published documents per year on Society 5.0 retrieved from the Scopus database

We calculated citation metrics for the retrieved documents by using Harzing's Publish or Perish. For the publication period between 2017 to February 2021, the retrieved documents received a total of 275 citations, 68.75 cites/year, and 1.94 cites/paper. We also analyzed the h-index, which measures the quality of research output based on the number of total citations received. The h-index and g-index of the retrieved documents were 7 and 13, respectively.

3.2 Research subject area

Scopus database allocates relevant subject areas to the documents in their indexing list. The top 10 research subject areas in the Scopus database are listed in Table 1. *Computer Science* and *Engineering* ranked first and second with total publication (TP) of 61 and 59, respectively. After that, *Social Sciences* ranked third with TP of 43, followed by *Business, Management, and Accounting* with TP of 28. Apart from publications from the apparent areas, extensive research works have been done in other disciplines due to the interaction of several industries. From the Scopus database, we observed *Mathematics* with TP of 22, and *Economics, Econometrics and Finance* with TP of 17.

Table 1. Top 10 Subject Areas Covered by Society 5.0

Subject Area	Total Publication (TP)	Percentage %
Computer Science	61	42.96
Engineering	59	41.55
Social Sciences	43	30.28
Business, Management and Accounting	28	19.72
Mathematics	22	15.49
Economics, Econometrics and Finance	17	11.97
Decision Sciences	15	10.56
Energy	13	9.15
Environmental Science	13	9.15
Earth and Planetary Sciences	11	7.75

Another interesting observation that can be concluded from Table 1 is the wide coverage of Society 5.0 that include other research disciplines such as *Decision Sciences, Energy, Environmental Science,* and *Earth and Planetary Sciences.* There are also subject areas categorized by Scopus that are not listed in Table 1 that accounted for less than 7% of total publications namely: *Materials Science, Physics and Astronomy, Chemical Engineering, Arts and Humanities, Medicine, Psychology, Agricultural and Biological Sciences, Neuroscience,* and others. This also indicates how research studies on Society 5.0 integrate interdisciplinary areas to solve real-life problems for various industrial applications.

3.3 Geographical distribution of publications and leading institutions

Our bibliometric analysis shows that the publications on Society 5.0 originated from 41 different countries. However, **Fig. 3** only shows the top 20 productive countries as we excluded countries that contributed to only one publication. Our analysis revealed that Japan is currently ranked first in term of the number of publications (n = 39), followed by Indonesia (n = 24), and the United States (n=9).

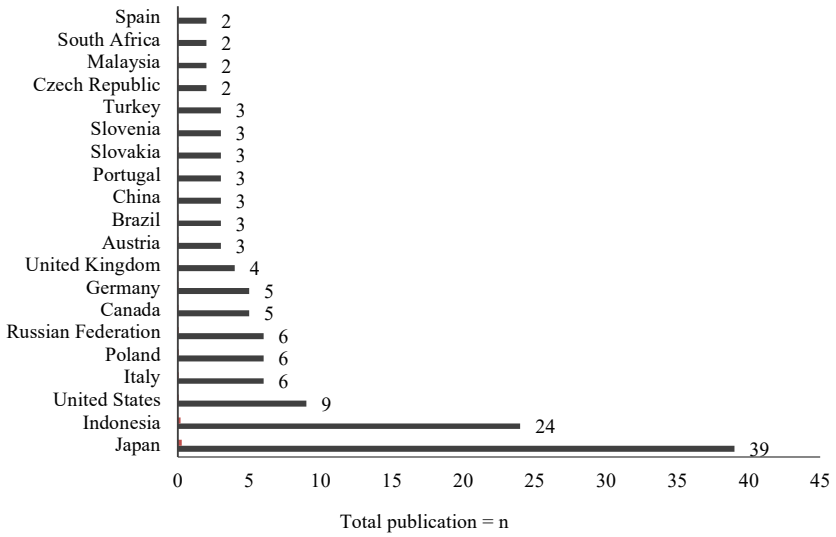

Fig. 3. Worldwide distribution of Society 5.0 publications from countries with more than one publication, 2017 – February 2021

Based on the dataset, we also identified the top 10 leading institutions with the highest number of publications. The University of Tokyo and Hitachi, Ltd is currently ranked first and second, with total publication (TP) of 7 and 4 documents, respectively. Keio University (Japan, TP = 4) ranked third, followed by Nagoya University (Japan), Univerza v Mariboru (Slovenia), Silesian University of Technology (Poland), National Institute of Advanced Industrial Science and Technology (Japan), Bina Nusantara University (Indonesia), Fachhochschule des Mittelstands (Germany) and Universidade da Beira Interior (Portugal). By identifying the leading research organizations, researchers who intend to venture into Society 5.0 research domain can reach out to these organizations for collaboration opportunities and technical expertise.

3.4 Key authors and intellectual structure of Society 5.0 knowledge base

Keyword co-occurrence analysis was used to analyze the intellectual structure of the present Society 5.0 knowledge base and to identify emerging topics in this research domain that have received the utmost attention from scholars. Similar to co-citation analysis, keyword co-occurrences analysis deciphers the similarity between the frequently used index and authors keywords in the literature. The relationship between two keywords is strengthened when there are more co-occurrences between the two keywords [5]. Therefore, current topics related to Society 5.0 can be determined, and potential future research direction can be predicted. For this study, we conducted a separate analysis of author keyword and index keyword co-occurrences. We also compared the network visualization maps produced by both analyses. As Society 5.0

is relatively a recent field of study, we set the keyword threshold = 2 for better visualization of keywords network. In comparison to the index keyword determined by Scopus, we found out that the author keyword co-occurrence analysis revealed a lesser number of keywords (keyword display = 36) (**Fig. 4**). The frequency of the occurrence is indicated by the size of the nodes. Each node is clustered using different colours, according to the co-occurrence network of multiple keywords. Network cluster maps of index and author keywords consist of the most highly used keywords in this research domain. Our analysis shows that Society 5.0 is closely interconnected with "*artificial intelligence*", "*Internet of Thing"* (IoT), "*cyber-physical systems*", "*big data analytics*", and "*smart society*". Besides, **Fig. 4** also shows connections between Society 5.0 and the United Nation's Sustainable Development Goals (SDGs) as indicated by the keyword *"SDGs"*, *"sustainability"* and *"sustainable development"*. Mapping of the author keywords also revealed interconnection between the keyword "*Society 5.0*" and "*covid-19*" in the retrieved dataset.

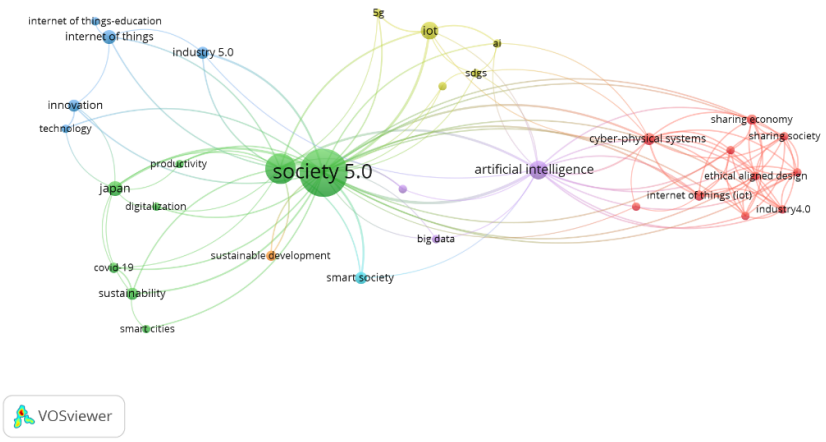

Fig. 4. Network visualization map of the author keywords (keyword threshold =2; display 36). Each colour represents different patterns of co-occurrences based on multiple keywords retrieved from the dataset.

Alternatively, the index keyword co-occurrence map (**Fig. 5**) shows 105 keywords display. Based on this result, we inferred that co-occurrence analysis using index keywords produced a clearer understanding of the current state of the art of Society 5.0 in comparison to author keywords co-occurrence analysis. However, the description of an article's content is more accurate with the use of the authors' keyword [6]. The index keywords of different clusters were presented in various colours.

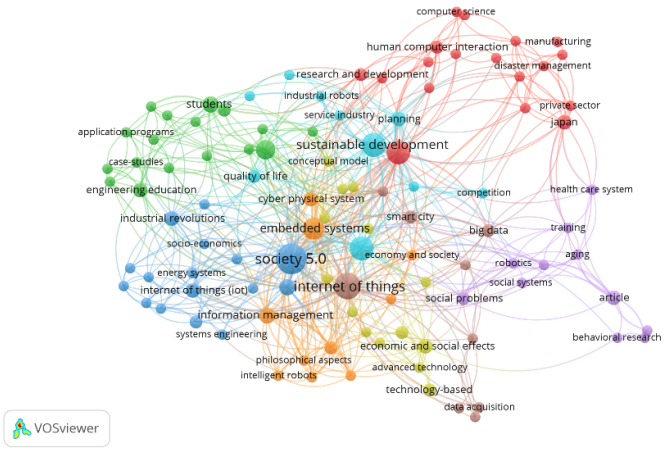

Fig. 5. This term map shows the state of the art of Society 5.0 literature based on index keyword co-occurrence analysis (keyword threshold =2; display 105 out of 696 keywords). Each colour represents different patterns of co-occurrence based on multiple keywords retrieved from the dataset.

Our analysis with VOSviewer revealed that the 105 index keywords of Society 5.0 were divided into eight clusters, which indicated eight different themes. The algorithmically grouped index keywords reflected topics that are closely related. Table 2 shows details of the eight clusters based on the index keyword co-occurrence analysis and specific keywords under each cluster. From Table 2, we observed that Cluster 1 has the highest number of keywords, which is 18. Cluster 2 and 3 each have 17 and 16, keywords, respectively. This shows that Cluster 1, 2, and 3 are the core research topics in the Society 5.0 literature.

Table 2. Eight clusters of Society 5.0 based on index keyword co-occurrence analysis

Cluster	Color	Number of keywords	Selected keywords
1	Red	18	artificial intelligence; computer science; computers; cost-effectiveness; decision making process; disaster management; government; higher education; human activities; human computer interaction; innovation, integrated approach; Japan; manufacturing; physical world; policy making; private sector; research and development
2	Green	17	application programs; case-studies; computation theory; customer satisfaction; decision making; education computing; education technology; education challenge; electronic commerce; engineering education; human machine interface; innovative learning; instructional designs; ITS applications; learning systems; man-machine systems; students
3	Blue	16	energy efficiency; energy management system; energy systems; engineering; industrial management; industrial revolutions; information and communication; Internet of

			Things (IoT); productivity; renewable energy resource; science and technology; smart power grids; Society 5.0; socio-economics; standardization; system engineering
4	Yellow	14	advanced technology; conceptual model; economics and social effects; Europe; knowledge management; manufacture; Poland (Central Europe); research work, sales, social development; technology-based; virtual worlds; visualization; well-being
5	Purple	11	aging; article; behavioral research; economic development; health care system; human; human experiment; robotics; social problems; social systems; training
6	Sky Blue	10	authentication; competition; digital technologies; industrial robots; industry 4.0; planning; quality of life; robot programming; service industry; sustainable development
7	Orange	10	cyber physical system; economy and society; embedded systems; industrial economics; information management; intelligent robots; intelligent systems, philosophical aspects, smart society, smart system
8	Maroon	9	3D printers; big data; data acquisition; data analytics; Internet of Things (IoT); Internet of Things; signal processing; smart city; social computing

Fig. 6 shows a temporal overlay on the keyword occurrence map (keyword threshold = 2, display =105), which connects keywords to the document's publication date. Therefore, researchers can determine the evolution of research terms periodically [5]. The nodes in darker shades (e.g., blue) indicates topics that were published earlier than those in lighter shades (e.g., yellow). The most recent 'hot' topics are represented by yellow nodes such as "*quality of life*" [11] and "*economic and social effect*" [12, 13].

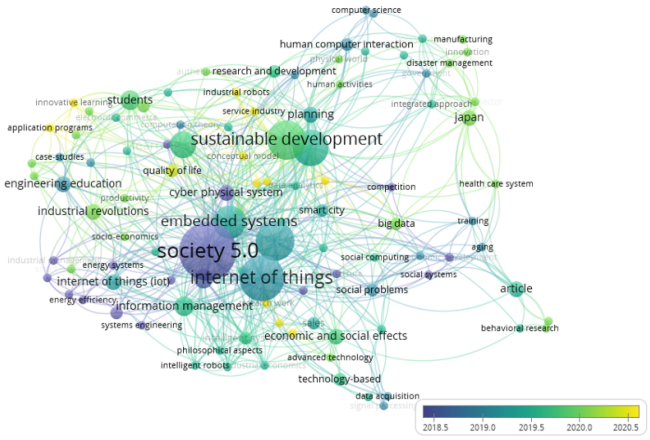

Fig. 6. Overlay visualization of index keyword co-occurrence analysis. Temporal overlay on keyword occurrence map (keyword threshold = 2, display =105) shows the evolution of research terms on Society 5.0. Overlay visualization by VOSviewer shows that circles with cold colours (e.g., blue) represent research topics with an older average publication year and the circles with hot colours (e.g., yellow) shows the terms with a more recent average publication year.

4 Discussion

This bibliometric review revealed a substantial knowledge base on Society 5.0 consisting of 142 Scopus-index documents published from 2017 to February 2021. We identified eight clusters of research themes in Society 5.0, which represent the current research direction. Our analysis shows that the intellectual structure of the knowledge base on Society 5.0 is primarily driven by IR 4.0 technologies such as the Internet of Things (IoT), big data analytics, and artificial intelligence (AI) to build smart cities integrated with cyber-physical systems. Due to the COVID-19 pandemic, the role and impacts of IR 4.0 are exponentially growing as many sectors were badly impacted due to the pandemic. Even though there is still a lack of empirical data to support this claim, reviews by Acioli et. al (2021) [8], Amaldi-Enchendu and Thopil (2020) [9] and Safraz et. al (2021) [10] provide some insights on the future research directions. The COVID-19 pandemic has triggered manufacturers globally to leverage advanced IT technologies such as AI, IoT, and robots [10].

Keyword co-occurrence analysis has been used to study intellectual structure in various research domains by many researchers. Kalantari et al. (2017) compared author keyword and KeyWords plus to examine big data research trends [19]. Analyzing literature retrieved from the Scopus database for documents published in 1994-2018, Udomsap and Hallinger (2020) used keyword occurrence analysis to conceptually structure the sustainable construction knowledge base [20]. The evolution trend of research topics as shown in the overlay visualization of index keyword co-occurrence analysis map (see **Fig. 6**) and steady growth in publication numbers suggest that research topics on Society 5.0 are progressively receiving attention from scholars. The maturity of a research field is assessed by these criteria: well-codification of literature, high accessibility to published documents, clear distinction with other research areas, vigorous research methods/approaches and research paradigm, high citation matrix (that indicate impacts on research community), and industrial applications [18]. Based on these criteria and referring to our findings presented previously, we deduced that Society 5.0 research domain is still under-researched and requires further attention from the academic community globally.

Our analysis also shows the role of the university as an important stakeholder towards developing Society 5.0. Besides solely focusing on teaching and academic research, the university has also embraced the third mission of the university, which is the commercialization of Intellectual Property Rights (IPR) [15]. One of the classic examples is the university-industry partnership between the University of Tokyo and Hitachi Ltd with the establishment of Hitachi-UTokyo Laboratory (H-UTokyoLab) [16]. Inclusive of the University of Tokyo and Hitachi, Ltd, 50% of the top 10 leading institutions with the highest total number of publications were based in Japan. This reflects Japan's standing as the pioneer and leader in developing Society 5.0.

This study is limited as it only used the Scopus database for the bibliometric review. Besides, it only presents the description of retrieved literature and keyword co-occurrences analysis. For future study, it is recommended to include other databases such as Web of Science (WoS) and Dimension.oi. In addition, it is also suggested to

conduct other bibliometric indicator analyses such as bibliographic couplings and co-citation analysis for a more comprehensive study.

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Determinants of the Adoption of Virtual Team Collaboration as a Mode of Knowledge Transfer within Innovation Driven Organisations

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Abstract. Society 5.0 seeks to resolve social and economic imbalances through the integration of the virtual world and the physical world. Amid the COVID-19 pandemic the need and possibilities hereof has become so much clearer. This paper aims to shed light on the factors affecting the adoption of virtual team collaboration within innovation driven companies, as their primary mode of knowledge transfer. By getting insight into these factors, we will be on our way to enable individuals, companies and governments to promote effective adoption of virtual team collaboration. This in turn can reduce the knowledge gap that exists in developing post-colonial countries, by enabling knowledge to be better transferred between industries within the country and from outside the country. This paper provides an in-depth coverage of the existing literature starting by looking into knowledge transfer as a management principle, then looking at the innovation of virtual team collaboration itself and finally at the social system, an innovation driven organisation, into which the innovation will be adopted. The findings are then applied to the Diffusion of Innovation theory's Innovation-Decision Process. By understanding these key determinants, organisations may utilise this guidance in the application of virtual team collaboration (VTC) as a mode of knowledge transfer when considering innovation.

Keywords: Society 5.0, Virtual Team Collaboration, Innovation Driven Organisation, Knowledge Transfer, Knowledge Management, Diffusion Of Innovation, Innovation-Decision Process.

1 Introduction

In the age we live in, remote work, long-distance communication and virtual collaboration is becoming more of a reality every day, driven by the rapid improvements of the technologies that enable this [1, 2]. The capability to make use of the available technologies, to effectively replace face-to-face collaborating teams, can be a competitive advantage to any organisation driven to innovate [3]. Companies have the opportunity to collaborate across continents and share knowledge in this way [3]. However, not only companies can benefit from these innovations, but also educational institutions, such as Universities, can collaborate across borders and share and create

knowledge not limited to a single country's viewpoint [4]. Countries that are leading the charge in innovation can become more and more competitive on a global scale

In contrast to this, the outlook for African countries is not entirely the same [5]. After reaching political independence, African countries have not quite achieved full independence from their overseas powers. In the context of technology, Africa and, for this study, South Africa (SA) is still very much dependent on developed countries for technology and South Africa is continuously in a game of catch-up. SA makes great use of industrial work, but not that much on technology development. Through this dependence, SA can be construed as a technology colony with a knowledge transfer gap between the industrial sector and design and development sectors [5].

Bridging the knowledge transfer gap would mean to create the availability of a scientific or technology skill base within the design and development stage of the technology life cycle in industry [5]. In this creating exposure opportunities for indigenous knowledge workers at all stages of the technology life cycle. Enabling them to add value to technologies at earlier stages of the life cycle [5]. This in turn, shifts the SA industry towards a service and knowledge work industry [6], which places the intellectual property in SA [5]. This will enable SA to export the technology from SA and have the financial stem of the technology within SA [5]. Through VTC technology's ability to remove traditional boundaries such as time or geographical location VTC can happen on a global scale and can increase the competitive advantage of companies in SA and increase their operational flexibility [7]. Companies can break the communication barriers of time and distance and make use of VTC to do so [1]. A study into what determines the adoption of VTC by companies in SA, can possibly play a role in closing this knowledge transfer gap that is currently present in SA.

Therefore, this paper aims to add to the body of knowledge of knowledge transfer as well as present an informative document sheading light for companies on how VTC can be diffused and better adopted to decrease the current knowledge gap. This is done by exploring answers to the question: "*What are the determinants of the adoption of VTC as a mode of knowledge transfer within innovation-driven companies operating in SA*?" An understanding of the key determinants may enable organisations to consider VTC

The following section (Sect. 2) provides and in-depth overview of the literature followed by the methodology applied in Sect. 3. Sect. 4 presents the exploration of an adoption model and the final section (Sect. 5) concludes the paper.

2 Background

The little research and development that is done in SA, is at tertiary institutions and very little of that is retained in the country, but rather transferred, at an early stage to the more fertile technology centres or "hubs" overseas. Very little research gets transferred to development and thereafter manufacturing within the borders of SA. This creates a knowledge transfer gap within the industry technology life cycle [5]. Knowledge transfer can be improved, in and into SA through virtual team collaboration (VTC). The need for better knowledge transfer arises on the level of a larger social

system, namely the country. But for this need to become addressed, it needs to become the need of multiple smaller social systems, such as companies or industries, in the larger social systems [8]. With improved adoption of virtual team collaboration, as an innovation, in organisations in SA, it might be possible to bridge this gap in knowledge transfer.

In the remainder of this section, an overview of knowledge transfers aspects, virtual team collaboration and innovation driven organisations are presented.

2.1 Knowledge Transfer

Knowledge can be described as information that has been processed by an individual [9]. Knowledge is either tacit or explicit [10]. Tacit knowledge refers to the concrete know-how and physical skills that one might attain through experience and repetition of certain tasks. It involves parallel processing complexities of current problems at hand, to develop a subjective understanding based on one's own values. In contrast to this, explicit knowledge is objective, discretely recorded knowledge that can be understood in a linear fashion upon consumption [10].

There are six knowledge management processes identified from literature that play an essential role in the transfer of knowledge. *Knowledge discovery and detection*, to recognise and categorise knowledge. *Knowledge organisation and assessment*, to ensure successful identification, retrieval and understanding of knowledge [11]. *Knowledge sharing*, which is an obvious part of knowledge transfer, but which is an incredibly important part and a critical competency any organisation needs to develop [9, 11]. *Knowledge reuse* of created knowledge, needs to be properly managed, since for a lot of companies this also is a source of competitive advantage[12]. *Knowledge creation* is implemented through practice, collaboration, interaction and education [10]. *Knowledge acquisition* meaning knowledge obtained from external sources [13].

Nonaka [10] observed that it is through continuous iterations of communication between individuals that ideas get developed into knowledge. This communication happens in communities of interaction such as work teams. In this study it is proposed that VTC can be used to extend the reach of these communities, by allowing inputs from overseas sources, at the inception stage [8, 14]. At the same time, this deviation from the norm of communication creates challenges to the effective transfer of knowledge.

Knowledge is one of the linchpins of an organisation's competitive advantage and the foundation for a lasting advantage as it cannot be easily transferred or replicated outside the organisation [15]. Knowledge is the justified belief or understanding of information on a subject that is obtained through previous experience and that enables an entity to take more effective action [1, 16]. Individuals form ideas in their heads and according to Nonaka [10] this is exactly where they remain unless validated through social interaction and knowledge transference. This interaction creates shared meaning within an organizational context and shapes the collective interpretation of events [17].

2.2 Virtual Team Collaboration

According to Townsend, Demarie [6, p.18], virtual teams (VTs) can be defined as "groups of geographically and/or organisationally dispersed co-workers that are assembled using a combination of telecommunications and information technologies to accomplish an organizational task. A slightly more recent definition of virtual teams states that it is a team that functions, through using technology in various degrees to collaborate, across locational, temporal and relational boundaries [18]. Virtual teams rarely, if ever, meet in a face-to-face setting". Although it was found that virtual teams are a more popular topic in research it was decided to differentiate between VTs and VTC, where finding VTC adoption determinants will be the aim of this study. Adding on to the definition of virtual teams, virtual team collaboration is the method of knowledge transfer between VT team members. Virtual team work has a lot of advantages and disadvantages for team members and although virtuality has sometimes been found to impede the performance of teamwork, this is not a unanimous finding as there are ways to mitigate negative effects of virtuality [3]. Mbatha, Ocholla [19] found that the use of information communication technology tools, and it is assumed by association VTC as well, is limited and underdeveloped in African countries. The companies that might need this most are especially the small to medium enterprises (SMEs) who are located in a single location, struggling to expand past certain physical borders [20].

Individual knowledge is legitimized by social interaction [10] it thus stands to reason that knowledge transfer should often occur within a team context. But the way we collaborate in teams can also be altered to include virtuality. Which might increase or decrease the efficiency with which this happens through the necessary tools and structures [2, 17, 21]. Virtual team collaboration is discussed through the dimensions of virtuality, tools and success factors to the effective use of VTC. Larson and Dechurch [22] define virtual collaboration as "remote communication through digital tools". Knowledge collaborations happens through activities between two or more people using a structured platform which enables them to achieve these objectives [1]. Add a dimension of virtuality on to that and you can infer that VTC is the method or design of knowledge transfer inherent in the way these VTs function. VTs are often temporary and only last for a predetermined time, which can have a negative effect on the members of such a team and does not give them a chance to build a shared meaning [17, 23] or social capital [1]. This is why it is proposed to use VTC as a primary mode of KT to improve the possibility of shared meaning building in VTs as they will be constantly in use and virtual social spaces can be structured as a necessary part of these companies [1]. The perceived ability to build shared meaning in temporal teams can possibly affect the adoption of VTC. In addition to this VTs should meet occasionally to improve these social structures, so an organisation's abilities to enable this occasionally over large distances can also determine whether the adoption of VTC will remain in place for an organisation[17, 24].

Among the challenges of using virtual team collaboration or working in virtual teams is the intercultural differences between members if the teams are geographically dispersed [17]. Cultural differences create a lack of shared meaning in a life world level.

This means that there are differences in how we automatically interpret information based on previous experiences. Creating this shared meaning based on other levels usually takes effort in any organisation and is easier to do in person[17]. South Africa is in a unique position of great multiculturalism, which means the individuals are better adapted towards cultural differences [25].

2.3 **Collaborative tools**

The improvements of collaborative technologies is what has enabled us to move in any instance from traditional face-to-face collaboration to different levels of virtuality over the years [26]. Collaborative technology is an overarching term used to describe tools such as wikis, blogs, podcasts, chat platforms, video conferencing, enterprise social media, messaging or emailing applications and file sharing platforms [22, 26]. And for a team to effectively use these tools, they need a certain level of information communication technology (ICT) competency and efficacy or self-efficacy. This self-efficacy can be a barrier to the adoption of VTC but can also be improved through training in these tools. So sequentially an organisation's perceived ICT training ability can also influence whether they decide to adopt VTC or not [27].

This said, VTC is media dependant, as collaboration in VTC is mediated through technologies, this makes them technology dependant [26, 27]. So a necessary requirement for VTC is some form of groupware technology, giving it the knowledge repositories and functionalities to create shared-objects-of-work amongst participants[17]. This space should allow for articulation of work, construct meaning around objects and agreements around how meanings will be assigned [17]. This technology should enable all the KT processes to be successful. VTC tools serve as a form of group memory enabling the re-use of knowledge by current members or induction of new members into what has been done [26].

The knowledge, skills, abilities and other (KSAO) characteristics of individual team members also influence the performance of a virtual teams [3] and whether members are perceived to have these KSAOs can be assumed to influence the decision to adopt or reject VTC. These KSAOs include for example: knowledge of media transfer, communication skills, willingness to trust others and share knowledge[28], ability to work with people from other cultures and, self-, time-, and project management abilities [3]

Collective KSAOs are important in any team, whether virtual or face-to-face and are for example cognitive emergent states of shared mental and transactive memory, affective mental states of cohesion and trust, and behavioural integration processes [22]. One of necessary characteristics to the performance of VTs, whether for individuals or the collective is the ICT efficacy and the training processes around the use of ICT [29]. How easily the technology can be implemented and adapted to the organisational structures also determines whether it will be adopted and used on a continuous basis.

The use of VTC as primary mode of transfer has certain perceived pros to its adoption by an organisation. It gives an organisation access to worldwide markets and can bring together experts and their knowledge regardless of location. It also has pros

to the individual within a team like flexible hours and reduced traveling times. It however also has disadvantages to it such as difficulty working with the technology, asynchronous communication in different time zones, new industry and organisational norms need to be established, and cross-cultural challenges across different countries or provinces. Some of the mentioned benefits can also become hindrances where a VT member working from home struggles to draw the line between work and their personal life causing conflict and mistrust in teams[7].The perceived benefits and disadvantages to the adoption on both an individual and organisational level is believed to influence the adoption decision of VTC [3].

2.4 Innovation Driven Organisations

Van De Ven [30] defines innovation as" the development and implementation of new ideas by people who over time engage in transactions with others within an institutional order". Described differently, innovation relates to the adoption or rejection of an idea that is perceived to be new. For this study, the adoption of VTC as primary mode of knowledge transfer will be studied through companies that is believed to include the idea of continually innovating processes as a part of their competitive strategy. This is because these companies are most likely to have previously adopted or rejected VTC or might plan to do so in the future. An organisation's innovativeness is thus already an antecedent to the adoption of any innovation [8], especially one that has a chance of increasing the interconnectedness of individuals in an organisation, which by itself will perpetuate innovativeness [8, p. 326].

Innovation should ideally also be at the frontend of an organisation's operations, rather than reactive to its environment [10]. Innovativeness is structured and defined by organisational leadership [22]. This consistent and endured innovativeness is an indicator of behavioural change. Where innovation champions for VTC are either opinion leaders within an organisation or part of the decision-making unit, innovation adoption is more likely to happen. [8, 31]. Diffusion and adoption of innovation needs to happen within a social system [8, p. 27]. The reasons for studies into innovation is either for marketing reasons or for strategic organisational management reasons [31], and this study aims to study adoption of innovation for both, but through the strategic management view of why an organisation would adopt VTC. It studies the adoption of innovation within an external social system of a country and through a study unit of an organisation.

Among the possible influences on an organisation's innovativeness is leadership and how agile, responsive and transformational it is [22]. Another factor is the organisational culture and willingness to embrace initiatives [32]. How the decision making is done within the organisation can also determine whether or not an innovation will be adopted, in other word how much power is in the hands of a small number of people can possibly negatively or positively affect the adoption of innovations [33]. Complexity of organisations (the level of experience and expertise) has been found to be positively correlated to innovativeness. Formality and interconnectedness within companies has been found to negatively affect the innovativeness of a company. Organisational slack (having more resources than needed) has been found to be

positively correlated to innovativeness, along with the organisational size [33]. An organisation that sees itself as entrepreneurial might also be prone to risk taking and it can be proposed that this might also influence its innovativeness [34]. An innovation also needs to fit into the organisational systems as is, without too much adaption [8].

For an organisation to be seen as an innovation driven organisation in this study, it thus has to constantly adopt new processes and exert innovative behaviour over a large period of time [31]. Ruvio, Shoham [35] confirmed 5 constructs that can also be used to measure an organisations innovativeness, and which will also be used along with traditional measure of number of innovations adopted over time. These are: *Creativity,* the focus of an organisation to adopt or creating new ideas. O*rganisational openness,* an organisational ability to flexibly respond to new ideas or industry changes. *Future orientation,* which is a temporal measure of how prepared an organisation is for future environmental changes and its positioning in perspective to these changes. *Risk taking,* the measure of how willing managers are to make large risky resource commitments, considering the possible gains or losses relating to these risks. *Pro-activeness,* an indication of a organisations pursuit of business opportunities to overcome inertia. Organisations with higher levels of innovation adopt more [35].

3 Methodology

The purpose of our research is to identify the key determinants organisations may consider in the application of VTC as a mode of knowledge transfer. design science where the research aim is on utility [36]. We followed a design science approach where the research aim is on utility, i.e. key determinants in this instance [37, 38]. In particular, we applied the design science research conceptual framework proposed by Hevner et. al [39] that consists of 3 aspects: environment, knowledge base and research.

Firstly, *environment* refers to people, organisations and technologies defined as business needs through organisational strategies, organisational structures, as well as roles and characteristics of people working within the organisations. Secondly, the *knowledge base* points to the scientific foundations such as frameworks, constructs or models, as well as methodologies such as data analysis techniques and measurement. *Research* is then conducted based on two complementary phases, develop and build, and justify and evaluate, guided by the articulated business need and anchored in applicable knowledge from the knowledge base.

The design artefact, in our study the determinants of the adoption of VTC as a mode of knowledge transfer, contributes in its application to the context where the business need was identified. By applying the proposed framework for information systems research, a research project addresses the utility of a new artefact and presents the evidence in support of the research project outcomes. Hence, the research problem, the artefact and its utility must be presented in such a manner that the implications for both research and practice are clear.

The scientific foundation that guided our study is Rogers' [8] innovation-decision process (IDP) i.e. the process an individual or decision making unit goes through sequentially when making a decision to adopt an innovation or not [8]. The phases of

this process include knowledge, persuasion, decision, implementation and confirmation. They are described by Rogers in his book Diffusion of Innovation [8], as:

- **Knowledge.** When the unit learns of the existence of the innovation and seeks to reduce the initial uncertainty about it through outlets such as mass media.
- **Persuasion.** When the unit evaluates the knowledge it gathered to form an opinion on the innovation.
- **Decision.** When the decision to start implementing it takes place and the innovation is groomed for implementation and if possible, it is used on a trial basis.
- **Implementation.** Comes after the decision and trial when the innovation is put into practice, but the user is still uncertain and needs assistance.
- **Confirmation.** When the unit seeks for reinforcement on the efficacy of the innovation and whether it should not discontinue its implantation.

The process is also illustrated along with the generic adoption determinants in Fig. 1.

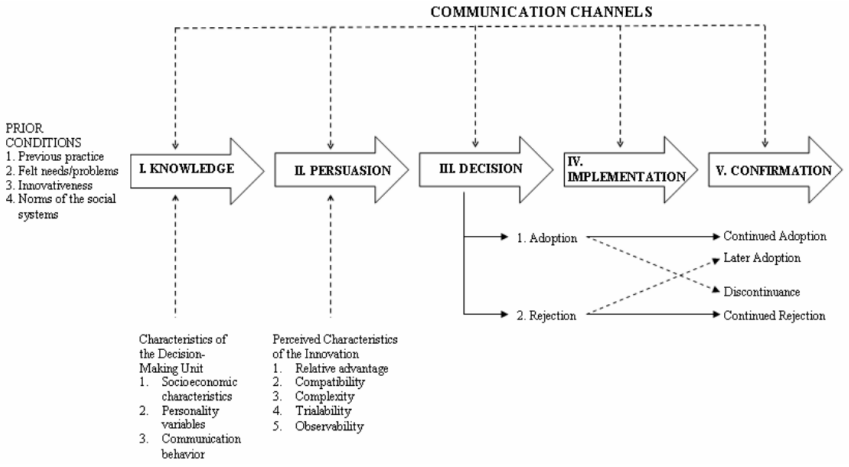

Fig. 1. Rogers's visualisation of the Innovation-Decision Process[8, p.185]

By applying this Innovation-Decision Process, we consider the key determinants of adopting VTC as knowledge sharing mechanism.

4 Exploring the key determinants of adoption of Virtual Team Collaboration for knowledge sharing

In order to directly relate the background knowledge to the adoption of VTC in Innovation Driven Organisations specifically, this paper proposes to view the process through a window of the three domains of research. These domains are the social system

within which the adoption takes place, the Innovation Driven Organisation in this case. The management principle of knowledge transfer and finally the innovation, VTC, itself which is adopted from an external environment. Finally, it is also suggested that the adoption of the innovation be viewed through the looking glass of the Innovation-Decision Process. Fig. 2 is an illustration of the how these different factors contribute to the determinants to adoption.

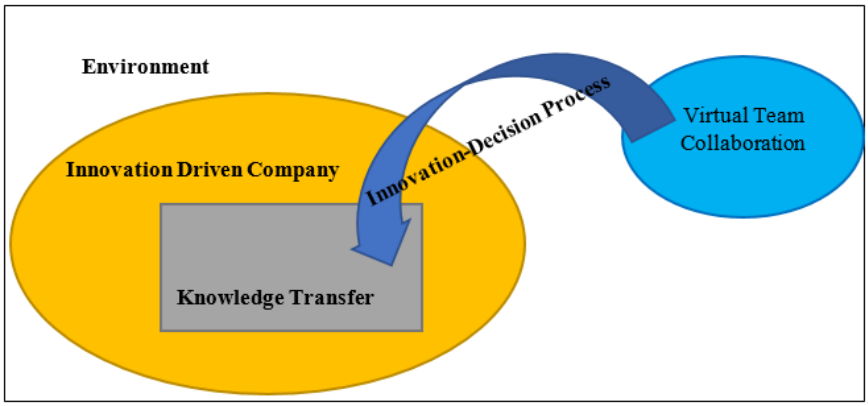

Fig. 2. Proposed interaction between adoption affecting factors (author contribution)

Fig.3 Shows the proposed mapping between the theory in Section 2 of this paper and the DOI model. These are only the primary determinants extracted from the theory and not an exhaustive list.

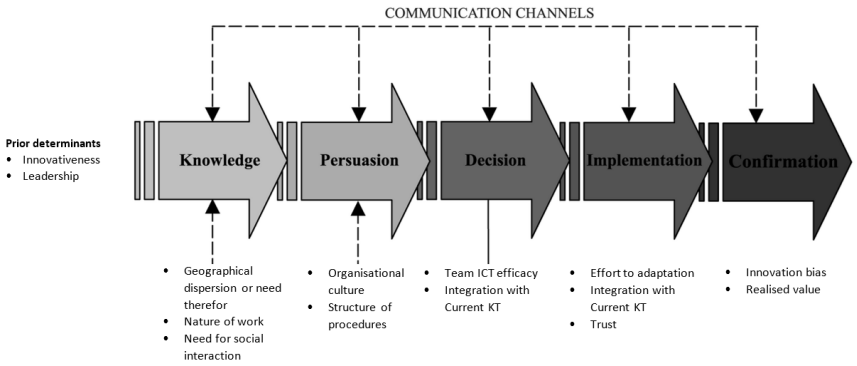

Fig. 3. Proposed DOI mapping for adoption of VTC as KT mode (adapted from Rogers [8, p.185])

In Fig.3 the authors compared the existing literature found in section two and placed the primary determinants from the literature into the different stages of the Innovation-Decision Process as defined in the DOI theory. This was based on the context of the

theory and where it was found to be most applicable, starting with prior determinants that affected the decision even before the organisation gathered any knowledge on the innovation and ending with the confirmation stage.

5 Conclusion

The paper shows multiple dimensions of factors affecting the adoption of VTC as a primary mode of knowledge transfer. These factors whether implicit or explicit can improve the way future research sees the adoption of this innovation.

By applying the information contained in this paper prospective adopters of VTC can see what to take into account when making their decisions. Companies and governments can promote the adoption of this innovation better than before and developers designing VTC tools can create a better product by taking this information into account.

Further to the research methodology and particular design science framework followed, this paper still lacks the application of industry knowledge through a possible longitudinal or cross-sectional study, which will be the next step to an ideal and practical view of what would determine the adoption of VTC as knowledge sharing mechanism.

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An Indoor Farming Framework for decision support towards food security in Society 5.0

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Abstract. One of the key aspects outlined in the Sustainable Development Goals (SDGs), is food security. The discourse around food security recognizes that resources such as water and land are finite, and the agenda to end hunger remains a major challenge. Furthermore, the objective of Society 5.0, to integrate digital technologies and a human-centered society to foster economic advancement and the resolution of social problems, augmented the reasons to address food security. Therefore, the purpose of this paper is to consider indoor farming as an agricultural technology capable of producing more food using fewer resources, as opposed to traditional farming, that is enabled through targeted capital investments. We developed an Integrated Farming Framework (IFF) with the aim to provide decision support to guide potential investors in indoor farming. Ten key aspects were identified and mapped to the Technology-Organization-Environment (TOE) framework, identifying a fourth construct, societal context. These constructs include the basic elements required for investors to consider financing in indoor farming projects. By applying the IFF, investors will be able to consider their investment options holistically.

Keywords: Society 5.0, Sustainable Development Goals, Food security, Human-centered society, Indoor farming, Investment, Decision Support.

1 Introduction

In 2020, the impact of the COVID-19 pandemic resulted in a significant increase in the number of people experiencing chronic hunger, adding up to 132 million to the already 690 million people (≈ 8.9% of global population) experiencing malnutrition and hunger globally [1]. This brings the achievability of eradicating hunger by 2030 as per the SDGs into question, calling for bolder actions on a global scale [2, 3]. The 2020 report on the *State of Food Security and Nutrition in the World* raises the need for modern and innovative approaches to address the growing social challenges in sustainable manners [1].

By seeking to employ technology in a more human-centered manner towards addressing social challenges, Japan's Government introduced Society 5.0 in 2016 as part of their growth strategy [4, 5]. The concept of Society 5.0 builds on the Information Society (Society 4.0) and promotes the development of information networks to create

value, by centering the use of technology and the digital transformation around advancing a human-centered society [5]. At the core of Society 5.0 lies the use of innovation and the technological advancements from Industry 4.0, such as artificial intelligence (AI), robotics and big data, to address social challenges including challenges addressed by the SDGs [5]. One of the seventeen (17) SDGs, number two (2), aims to zero hunger by achieving food security and improving nutrition through several global intervention actions, including the promotion of sustainable agriculture [6-8]. As it is the goal of Society 5.0 to enhance society through a close collaboration with technology (i.e. AI and autonomous systems), it is necessary to determine the holistic impact Society 5.0 may have on chronic social problems such as hunger.

This paper aims to contribute to the body of knowledge of Society 5.0 within the context of SDGs by considering the following research question: *"How can an Indoor Farming Framework (IFF) be applied towards decision support for food security in Society 5.0".* Through the systematic review of available Society 5.0 and indoor farming literature, the paper proposes an IFF aimed at providing potential investors with key consideration for investing in indoor farming with the objective of addressing food insecurity.

In the next section (Sect. 2), an overview of the literature is provided, followed by the research approach in Sect. 3. The data analysis and findings are presented in Sect. 4, with Sect. 5 proving the research contribution of an IFF. Finally, the paper is concluded in Sect. 6.

2 Background

Food insecurity, unlike Society 5.0, is not a novel idea. In 1798, Thomas Malthus predicted food production will be superseded by population growth and reiterated his hypothesis in 1826 stating that "*population has this constant tendency to increase beyond the means of subsistence*" [9, 10:14]. Although the definition of food (in)security has evolved over the last century, hunger remains a persistent social challenge globally [1, 7]. The paper aims to determine to what extent the Society 5.0 approach can be applied in finding solutions for global food insecurity in a sustainable manner. Sect. 2 provides an overview of Society 5.0 and food security, followed by an introduction into indoor faming, and information system frameworks capable of providing decision support to potential investors in the agricultural sphere.

2.1 Overview of Society 5.0

Society 5.0 principles aim to resolve modern social challenges by merging the real world with the virtual world in a manner where humans or society remain at the center [5]. Following the Information Society (Society 4.0), where technology advances have been extensive, Society 5.0 intends to guide the mobilization of innovation and technology to ensure a sustainable future, balancing economic and social advancement [5, 11]. This human-centered approach allows for additional value creation in products and services by addressing gaps and social problems through the connection of technologies

and the physical space in a sustainable manner. This goal aligns with the United Nation's SDGs to promote action towards a sustainable future for all [12]. AI, big data, the internet of things (IoT), and robotics are some of the technologies utilized to create social value and address digital divides [13].

On the other hand, the challenges of implementing such lofty goals include ethical concerns, for instance privacy and security in both the physical and digital space, and barriers to technological adoption [5]. In addition, a super-smart society (Society 5.0) requires an extensive level of technological transformation that will allow for tackling of social challenges [3, 13]. Where diversity, social inclusion, cultural balance, innovation, and global perception promote acceptance of technology through positive experiences [14]. To address these challenges, a conscious and purposeful process is required to create a sustainable future through societal evolution.

2.2 Overview of Food Security

Napoli [15] and Kruzslicika [7] provide a thorough background of the evolution of food security and its definition, highlighting the core aspects associated with food security with the progression of time [7, 15]. Although food security is a difficult concept to define and measure, the Food and Agriculture Organization (FAO) defines food insecurity as "*A situation that exist when people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development and an active and healthy life*", opposed to food security defined as "*when all people, at all times, have physical and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preference for an active and healthy life*" [15:7-9, 16, 17]. Subsequently, food security considers more than just the **availability** of food, it requires a holistic improvement to the entire food value chain, including **stability**, **accessibility,** and **affordability** as well as the safety and nutritional value of produced food and how it is **utilized** [15, 16].

To mitigate the significant impact of the COVID-19 pandemic on the agriculture and food sector, the FAO is imploring swift global action [2, 6]. The FAO has provided several policies and strategies to establish resilient food systems in areas where food insecurity persists. One of these strategies, the Twin-Track Approach, aims to address the key areas of food insecurity by combining rural development with sustainable agriculture [16, 18]. By fostering sustainable agriculture, social and environmental sustainability can be promoted alongside economic growth. Therefore, sustainable agriculture has the potential to mitigate environmental, social, and economic challenges [19, 20]. In support of this, Kruzslicika [7] also highlights the important role sustainable agriculture and the responsible use of resources play in working towards food security [7]. However, to establish sustainable agriculture and promote rural development, funding and support is required, especially in low-income regions [18, 21]. As the world population continuous to grow and consumption patterns shift, the demand for food increases, adding to the increasing resources requirement that put agricultural systems under great pressure [22]. The increase in resource requirements alone, escalates the food crises further, as food production and distribution are further burdened [22]. Considering the plight of Society 5.0 to address social challenges, one innovative approach

to producing food with minimum resource requirements, whilst minimizing natural interferences (i.e. rainfall and sunlight), is found to be Controlled Environment Agriculture (CEA), otherwise known as indoor farming [23-27].

2.3 Indoor Farming

Constraints on natural resources, such as water, requires agricultural practices to find sustainable avenues of producing more food with less resources to play its role in addressing food security [20]. It is the objective of sustainable agriculture to conserve and protect resources while meeting the social needs and not compromise the ability to produce adequately for future agricultural needs [7, 8, 20]. The application of indoor farming technology has evolved significantly in recent years, providing farmers with the ability to produce crops with minimum resources and space, while simultaneously reducing the use of harmful pesticides and fertilizers [23, 24]. In addition, indoor farming complements already established urban and rural farming systems using technologies such as IoT and AI [23, 24, 28].

There are several types of indoor agriculture, ranging from tunnel farming that requires minimum technological input to highly autonomized and controlled systems such as container farming [23, 24, 28-31]. The growing environment (i.e. vertical farms) and growing methods (i.e. hydroponics) require varying levels of technologies [28, 29]. A CEA approach to indoor food productions allows for the utilisation of technology to optimise growing conditions for crops and extend growing season [26, 27, 32]. These enclosed structures provide farmers with the option to control variables such as humidity, temperature and nutrient solutions through the utilisation of a variety of technology and information systems [26, 31, 32]. Although this form of sustainable indoor farming is resilient to various climate conditions, there is still a risks and costs that must be accounted for during the development and design of these projects [23]. As a result of the high start-up cost of indoor farming initiatives, exposure to the market is limited [23]. However, indoor farming may serve to address high operating cost such as fertilisers, transport and water [26]. Regardles of the initial cost associated with indoor farming, Sulser et al. [33] emphasised that investment in agricultural sphere is essential to achieve results in reducing food insecurity [33]. Furthermore, Antornaras & Kostopoulos [8] highlights the crucial role private investors play in the development and implementation of practical and scalable sustainable agricultural solutions addressing social challenges such as food insecurity [8, 23]. To guide investors in the process of investing in the diffusion of farming technology, decision support frameworks can be used as described in the next section.

2.4 Decision Support Frameworks

Petry, Sebastiao, Martins, & Barros [34] notes that innovation, usally associated with the contribution of new resources and knowledge, in the agricultural sphere typically relates to the increase in production, crop quality and improved production processes [34]. When considering the principles of Society 5.0, technology must be diffused within the social system through a process of information flow to advance the spread and acceptance of technology [13]. Where a decision support framework is an

information system solution to support problem solving and complex decision making [27, 35, 36]. Tornatzky and Fleischer's Technology-Organisation-Environment (TOE) framework is one such information system model that facilitates the adoption of innovation [37]. The framework consists of three constructs that consider what may influences the process of technology adoption in organisations [37, 38]. Where the technology contexts consideres the available technology for adoption as well as what is already established within the organisation [38]. Secondly, the organisational context considers the organizational structure, size and communication processes [36]. The final construct, environment, looks at elements such as market structures, infrastructure and external support, including governmental regulations [38].

Although TOE frameworks have been used in other sectors to develop a decision support system that looks at the adoption of sustainability initiatives throughout the value chain and the systems lifecycle, there is little reference to the application of the diffusion framework applied in the agriculture sphere found in literature [38, 39]. The framework considers the technological, organizational, and environmental context wherein the system lies and highlights decision factors for the adoption of specific technologies within the sector. It should be noted that the adoption of innovation and knowledge transfer in the agricultural sphere is influenced by several factors [40]. Diederen, van Meijl, & Wolters [40] also note that market position and access to information is one of the contributing factors to the adoption of innovation [40].

3 Research Approach

The goal of this paper is to provide potential investors with a decision support framework for investing in indoor farming with the objective of addressing food insecurity. To establish this decision support framework that supports investors in the agricultural sphere, a systematic literature review (SLR) is used to identify the key considerations or themes for investing in indoor farming. Where a SLR identifies, evaluates and synthesizes the existing body of knowledge produced by practitioners, researchers, and scholars to answer the stated research question [41]. The SLR follows a clearly defined replicable protocol to conduct a comprehensive search over various databases and grey literature (i.e. technical reports) [41, 42]. Strings of keywords were used to search specific and inclusive peer-reviewed literature published in various approved academic databases as well as to search for grey data published in technical reports found using the Google search engine. Keywords and phrases included "Society 5.0", "food (in)security", "SDG", "sustainable agriculture", "indoor agriculture and farming", "investing in indoor farming", and "innovation and technology diffusion", as well as derivatives thereof. Strings of keywords were also used to refine and focus the literature search, although predominantly sources from 2016 onwards were included, as this was the year when Society 5.0 was introduced. However, older literature is also included to address long standing social challenges and agricultural practices. The total number of articles and technical reports that match the key terms are indicated in Fig 1.

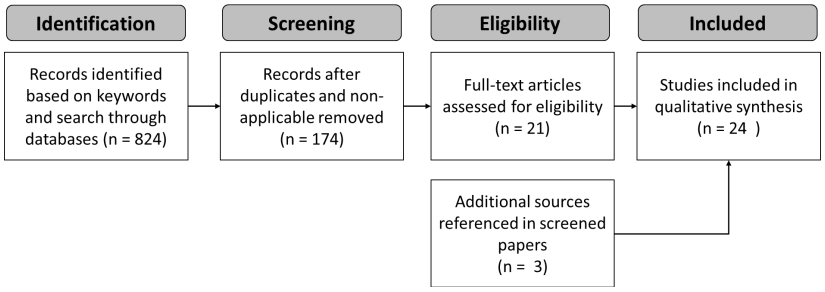

Fig. 1. The number of reports and papers found on databases and grey-literature sources

Although the initial search identified 824 papers and reports, a screening process was applied to refine the search against specific criteria. Papers and reports were excluded if they were found to be duplicates, non-English publications, not relevant to the research question or were unobtainable. After the application of the initial screening process, 174 papers and reports were selected. The detailed screening process of the prospective papers found that 153 documents were excluded based on exclusion criteria such as unrelated context and studies not addressing the research question. During further iterations of framework development, three (3) sources were additionally included in the final SLR.

4 Data Analysis and Findings

The paper aims to develop a conceptual framework that will provide potential investors with key considerations for investing in indoor farming to sustainably address food insecurity. Key considerations have been grouped using a process of thematic analysis as shown in Table 1 [43]. The first column indicates the primary themes as context elements, while the second column indicates the secondary theme as mapped from the TOE framework. The third column provides key considerations, and the final column indicates the applicable references.

Themes were identified by considering the Tornatzky and Fleischer's TOE framework structure as a baseline. However, several themes derived from the SLR could not be mapped according to the TOE framework. These themes address the social challenges associated with food insecurity and were included through the addition of a new primary theme, social context (shaded grey).

The first primary themes emerging from the SLR relates to the *organizational context* of indoor farming. Within the organizational context, consideration is given to secondary themes that link the indoor farming value chain, both formally and informally, as well as the organizational size, communication processes and logistical elements. Where elements to consider before investing in any agricultural sector include a range of interlinking components that stretch from preproduction to the point of sale of the food produced indoor. Secondly, the *environmental context* serves as the second primary theme where the industry's characteristics, legal regulations and practices, as well as technological infrastructure are considered. These considerations, both physical and

human related, play a significant role in the feasibility of indoor farming investment. The third primary theme is identified as the *technological context*, that emphasizes the influence of innovation diffusion and the availability of technological features on the successful adoption of indoor farming. Considerations include the availability of technology and the organizational characteristics such as the organizational ideals, resources, and investment budget. In addition to the traditional structure of a TOE framework, the shortfall of social construct consideration is included to produce an extended IFF framework to address the final primary theme. Furthermore, the extension of the framework allows for the alignment with SDGs and Society 5.0 principles. Hence, the *social context* serves to address the aspects of social development and achievement of food security through the adoption of indoor farming.

Table 1. Extracted IFF themes and sub-themes

Primary Theme	Secondary Theme	Key Considerations	References
Organizational Context	Formal and informal linking structure	Pre-Production	[7, 8, 22, 26, 27]
		Production	[22, 27, 40, 44]
		Harvest	[22, 27]
		Processing	[22, 27, 40, 44]
		Distribution, Packaging & Handling	[22, 23, 27, 40]
		Point of Sale	[22, 26, 27]
		Disposal/End of Life	[27]
	Communication Processes	Regulations & Government	[8, 23, 40, 45]
		Associations	[8, 31]
		Community	[8, 26, 40]
		Business Development	[8, 27, 33, 40]
		Suppliers & Service Providers	[8, 27, 33]
		Target Market	[26, 33, 40]
	Size	Farm Size	[26, 40]
		Location/Climate	[8, 23, 26, 27, 31, 32]
		Labor Requirement	[23, 26]
		Harvest Size	[26]
		Investment Cost	[8, 23, 26, 27, 31, 33]
Environmental Context	Industrial Characteristics and Market Structure	Consumer	[23, 26]
		Market Structure	[26, 27]
		Competitors	[26]
		Suppliers & Service Providers	[8]
		Investors & Stakeholders	[8, 26, 27, 40]
	Technology Support Infrastructure	Crop Technology	[3, 8, 26, 27]
		Level of Farming Technology	[23, 26, 27, 31, 32, 40]
		ICT & IS	[3, 14, 26, 32, 44]
		Skill Development & Training	[8, 23, 26]
		Data Management	[3, 14, 27, 32, 44]
		Maintenance & Upgrades	[26, 31]

Primary Theme	Secondary Theme	Key Considerations	References
	Government and International Standards and Regulations	Quality Assurance	[27, 31]
		Food Safety	[26]
		Health & Safety	[8]
		Community Relations	[8, 26, 40]
		Technology	[40]
		Inputs (i.e. Seeds, fertilizer, etc.)	[7]
		Water, Energy & Waste Management	[7, 23, 27, 32]
		Site & Facility Management	[26, 45]
		Financial & Business Management	[26]
		Certification	[8, 23, 45]
Technological Context	Availability	Inputs (i.e. Seeds, fertilizer, etc.)	[3, 8, 26, 27, 46]
		Indoor Farming Structures & Material	[23, 26, 40]
		Farming Technology	[3, 23, 26, 27, 46]
		Information Systems	[3, 14, 26, 27]
	Characteristics of the Organization	Resources	[26, 40]
		Budget (Time/Cost)	[27, 32, 40, 46]
		Ideals	[26, 27, 40]
		Production Goals	[8, 46]
		Skilled Labor	[8, 23, 40]
Societal Context	Social Development	Heritage/Culture	[26]
		Tenure	[26]
		Women Development	[7, 47]
		Education	[7, 8, 26, 40]
		Extension Services	[7, 32]
		Self-Reliance	[7, 8, 26, 46, 47]
	Food Security	Access	[1, 7, 16-18, 23, 26, 31, 32, 48]
		Availability	[1, 7, 16-18, 26, 33, 48]
		Utilization	[1, 7, 8, 16-18, 44, 48]
		Stability	[1, 2, 7, 16-18, 44, 48]
		Sustainability	[5-8, 23, 26, 27, 46]

Ten secondary themes were mapped to create the four primary themes namely organizational context, environmental context, technological context and the societal context. In the next section we discuss the primary and secondary themes and how it contributes to proposing an IFF in more detail.

5 A Conceptual IFF Model

From the analysis in Table 1, combining the themes from literature and by mapping the key considerations to TOE, the existing TOE framework has been enriched to create an IFF. This IFF model aims to provide potential impact investors with key considerations for investing in sustainable indoor farming.

The conceptual IFF in Fig 2 derived from the raw data in Sect. 4 is created across the four constructs, namely technology, organization, environment, and social context. Despite the arrangement of the TOE framework structure around the adoption of technology, the organizational context provide the base around which the remaining constructs are centered. The *organizational context* observes the characteristics of the farm, considering the structure, scope, and size as well as the communication processes. These considerations provide potential farmers with a set of key considerations that guide the decision-making process for investing in indoor farming technology. Themes identified in Sect. 4 were aligned with the skeleton structure of the TOE framework, highlighting variables potential investors need to take into account prior to investing in an indoor farm. When considering the informal and formal links in an organization (the farm), attention should be given to the complete life cycle of the indoor farm, from preproduction elements that include the preparation of facilities, information systems, pesticides and seeds, up to the logistics and management associated with marketing and the sale of produced food. Furthermore, the market players that serve to support the core farming activities include the government, employees, nonprofit organizations (NPO), associations and business membership which need to be established. Also, investors need to consider the available support network as well as the size of the farm. As the size of the organization refers to more than the farm size, consideration must be given to the location, harvest size, investment cost, and required workforce.

The *environment context* does not only consider the market structure and industrial characteristics but also the technology support infrastructure and associated regulations and standards underlining the production of food. Investors are to consider the distance to consumers, competitors' operations and products, market structure, and suppliers as well as stakeholders in the indoor farm. The infrastructure for supporting technology is another essential consideration that emphasizes the necessity of understanding how effectively various forms of technology can be used to support food production. Crop technology (i.e. increased nutrient content), information systems, training, data management and maintenance are some of the considerations associated with the environmental technology support infrastructure. Finally, the organizational environment needs to look at the underlying regulations, standards and governmental objectives addressing food safety, community relations (i.e. labor laws), health and safety, facility and site management, production input (i.e. seeds and fertilizers), water and electricity use, financial management and farming certification.

Conversely, the *technological context* considers the availability of the technology to be adopted as well as the organizational characteristics. For indoor farming to be diffused in the traditional agricultural space, the availability of suitable inputs (i.e. seeds, nutrients and growth mediums), indoor farming structures and materials, farming technologies and information systems need to be considered. The investor is encouraged to

align these considerations with the characteristics of the organization itself, looking at the resources, budget, ideals, production goals and the availability of skilled labor, including the farmer.

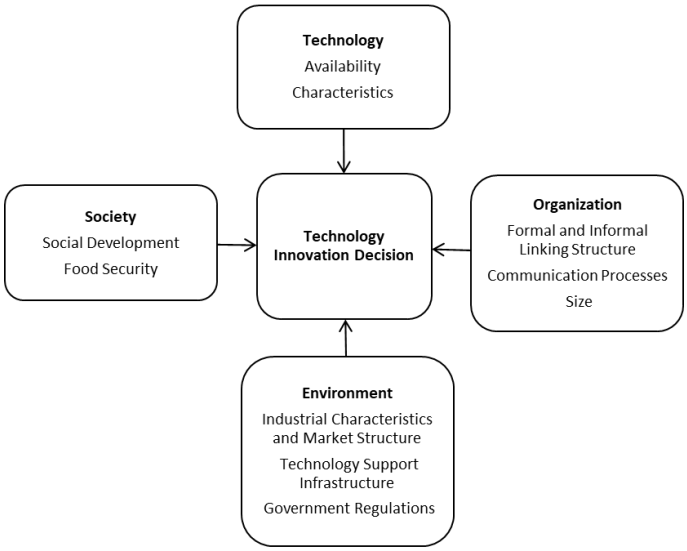

Fig. 2. Conceptual Indoor Farming Framework for Decision Support towards food security.

The IFF model strives to provide potential investors with a complete range of considerations for the adoption of indoor farming as a potential solution to sustainably addressing food insecurity through impact investment. Hence, consideration is given to social aspects not addressed in traditional TOE frameworks. The *social context* is concerned with two main themes, social development and food security. Where social development addresses factor such as tenure, education, extension services, women upliftment, as well as heritage and culture protection to promote self-reliance. On the other hand, the food security theme emphasizes the four pillars of food security (access, availability, utilization, and stability) and the sustainability thereof. *Access* does not solely refer to access to food but, also access to markets, assets, labor, guarantees and institutions, while *availability* considers the land, production, and market investments available to the investors and the community. When considering the *utilization* of food, the knowledge of nutrition, food preparation, food safety and storage processes are essential to effectively address food security challenges by ensuring that available food is nutritionally sufficient. The final pillar, *stability*, requires the investor to look at diversifying crops and labor, risk management, security and safety as well as promoting peaceful relations among governance and communities. All these factors need to be considered with sustainability in mind, to ensure social and economic challenges are addressed for the future by supporting the environment.

6 Conclusion

Although the international community have committed to the agenda set out by the SDGs to end hunger, food insecurity remains a major challenge. With the human-centered nature of Society 5.0 and the objective to achieve sustainable food security, effective targeted investments in agriculture are required. Indoor farming is an agricultural technology capable of producing more food using fewer resources in comparison to traditional farming methods. The purpose of this paper is to present a conceptual framework that will provide decision support towards improving food security. This proposed IFF contains four main constructs derived from a two-step process of SLR and thematic analysis. These constructs include the basic elements from the TOE framework with an extended primary construct that considers the social context of investing in indoor farming for addressing food insecurity. The primary constructs include technology, environment, organization, and social context with underlying key considerations. By applying the IFF, investors will be able to consider a broad range of holistic elements associated with indoor farming investment to mitigate the risk of incurring unplanned expenditure, legal restraints, operational and technological restrictions, as well as social and cultural problems. Furthermore, investors using the IFF as a decision support tool will be required to consider far reaching impacts prior to investing capital to ensure a successful operational indoor farm capable of supporting food security goals.

This extended framework serves as a conceptual model that can be validated through further research to align the framework model with real-world scenarios.

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Does Board Composition Taking Account of Sustainability Expertise Influence ESG Ratings? An Exploratory Study of European Banks

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Abstract. In the context of the European Green Deal, the European Commission opened a consultation on the realignment of corporate governance with key aspects of a sustainable economy in late 2020. Based on the understanding that board composition is considered a key factor to promote sustainable business management (EU Commission & EY, 2020), the European Commission is considering enforcing legislative measures regarding sustainability expertise on boards. Why sustainability expertise on boards drives sustainability forward is substantiated by different theories, such as the resource dependency theory, human capital theory, agency theory and social psychological theory (Carter et al., 2010). Academic literature in the area of ESG performance in relation to board characteristics most widely uses the variables (gender) diversity, the share of independent directors, board size and the existence of a sustainability committee (Birindelli et al., 2018). The impact of sustainability expertise on ESG performance has not been studied so far. This study examines if the number of board directors with sustainability expertise and sustainability leadership have a positive effect on the ESG ratings of EURO STOXX Banks 30. Results indicate that sustainability expertise on boards and sustainability leadership with major European banks is still rather low. Encouraging results could be found supporting the hypotheses.

Keywords: Sustainability, Board Composition, Banks.

1 Introduction

Following legislative measures, such as the European Green Deal [3] and the communication on the COVID19-recovery plan [4], the European Commission opened a consultation in late 2020 on the realignment of corporate governance with key aspects of a sustainable economy. The consultation aimed to find views and inputs from different stakeholders on topics being part of the United Nations Sustainability Development Goals (SDGs), such as board compensation to be complemented by longer-term goals including sustainability risks and opportunities, directors' duties regarding the balancing of interests of a broad range of stakeholders with rather short-term oriented shareholders, sustainability expertise on boards, pollution and many more [4].

To increase sustainability expertise on boards, the options the European Commission is considering range from soft to hard law, e.g., from promoting the consideration of sustainability related expertise in the nomination process up to a new EU directive requiring companies to consider sustainability criteria in the board nomination process [3]. The consultation period ended on 8 February 2021 and raised several stakeholder reactions highlighting disadvantages of potential legislative measures on board composition [6,16,17].

2 Theoretical Background, Literature Review and Hypotheses

2.1 Theoretical Background and Literature Review

The United Nations Global Compact initiative reports that it "is now firmly acknowledged by researchers, investors and executives that corporate sustainability is key to long-term profitability and viability of most, if not all, companies" [23, p.4].

Board composition is considered a key factor to promote sustainable business management and a focus on the long-term [3,10, 28], with other factors such as alignment of the interests of the company and directors' duties, shift of investors' focus to the long-term and board renumeration also playing an important role [3]. Currently, the number of appointed directors with sustainability expertise is still limited [27]. This applies to both board committees focusing on sustainability as well as independent advisors [3,27]. Studies [9,26] found that only a quarter of a sample of international companies covered had one director with ESG, ethics or social responsibility experience and out of more than 600 US companies, only 19% had a board member with sustainability expertise.

Why sustainability expertise on boards drives sustainability forward is substantiated by different theories, such as the resource dependency theory, human capital theory, agency theory and social psychological theory [5]. These theories aim to explain how external resources of the organization (resource dependency theory [22]), e.g., the board of directors, and their education and experiences (human capital theory [8]), their degree of independence (agency theory [7]) and diversity (social psychological theory [25]) may influence the behavior and performance of the organization.

Further empirical research has shown the importance of the role of the board in identifying and working with management on ESG issues [30] given the reputational impact, the public, investor and stakeholder relations dimensions and the impact on the bottom line [21,27]. Research results suggest that directors and selected employees educate themselves on ESG issues relevant for the company [21]. In this context, it is acknowledged that "the absence of relevant knowledge and expertise inside the board might significantly undermine a board's capacity to identify and discuss sustainability risks and impacts" [3, p.3].

Academic literature on ESG performance in relation to board characteristics most widely uses the variables (gender) diversity, the share of independent directors, board size and the existence of a sustainability committee [30]. Diversity encompasses different perspectives such as age, gender, nationality, race as well as different backgrounds and experiences – including sustainability expertise [3]. Diversity drives sustainability

forward, as it promotes vision and strategies in both economic [3] and extra-financial areas [10,28]. Various researchers with a focus on gender representation show a positive impact of female board participation on ESG performance [20,31] or financial performance [11,18,20], a positive impact related to specific circumstances such as firms with weak governance [32,34] or an inverted U-shape relation [30]. Others found no impact on financial performance [5,8,33]. The independence of board members serves as well as catalyst for firms to promote social responsibilities in their business activities [15,24,31]. According to Birindelli et al. (2018) other studies did not find this link, leading to an overall inconsistent set of research findings regarding this variable.

Some researchers have found the positive impact of sustainability and / or governance committees on ESG ratings in the Gulf region [31] and for European banks [30], which is the usual board characteristic to study sustainability expertise. So far, it has not been explored if besides the existence of a sustainability committee, the sustainability expertise of board members has an impact on ESG performance. Neither on a regional nor on an industry level. The WBCSD (2020) considers banks one of the industries which should along with other high-risk sectors focus on the duties of directors regarding ESG issues. The banking sector - through its financial intermediary function – is one of the key sectors to promote the transition to a more sustainable economy [30]. Therefore, this study focuses on the impact of sustainability expertise on the ESG ratings of European banks. Results can contribute to the discussion whether legislative action in the area of board composition and sustainability expertise might foster sustainable business management in Europe's largest banks.

2.2 Hypotheses

Resource dependence theory and human capital theory provide a sound theoretical basis why sustainability expertise could influence the behavior or organizations towards sustainability. The agency theory and social psychological theory provide a less clear reasoning. Theory and empirical studies [30,31] do suggest that the link between sustainability expertise and ESG performance is positive.

To test whether a law on a quota for sustainability expertise on board would make sense and impact the sustainability practice in firms, the following main hypothesis has been formulated:

Hypothesis 1: The number of board directors with sustainability expertise has a positive effect on the ESG ratings of EURO STOXX Banks 30.

The second hypothesis takes account of the fact that the consultation does not differentiate between the board of directors or executive board. Following Alm and Winberg (2016) who studied the impact of female leadership on firms' financial performance, sustainability leadership will be measured with either the Chairperson or the CEO having a sustainability-oriented profile on the firm's website.

Hypothesis 2: Sustainability leadership has a positive effect on the ESG ratings of EURO STOXX Banks 30.

3 Data and Methodology

3.1 Data

Data on ESG ratings and further financial data has been collected from Thomson Reuter's DataStream. Data on board of directors' composition collected from Thomson Reuter's DataStream and is manually complemented from corporate websites. Data includes major European banks from the EURO STOXX Banks 30 index and consists of 30 banks. Following recent studies [5,30,31] a 5-year panel dataset (from 2015-2019) has been constructed. The overall sample consists of 1375 director-firm-year observations, after deletion for missing values.

The ESG performance rating from Thomson Reuters has been used following recent studies [30] as dependent variable to test the hypotheses. The study is focusing on the impact of sustainability expertise on ESG ratings of European banks; therefore, the independent variables of primary interest are sustainability expertise on board level (SUSTEXP) and sustainability leadership (SUSTLEAD). Following previous research [5,30], different types of control variables were used, e.g., the share of women on the board of directors (WBOD), the share of independent directors (BODIND), board size (BODS) and the existence of a sustainability committee (SUSTCO). In line with previous research [5,30] additional control variables are added, which might influence the ESG rating. These are bank size (BANKSI), return on equity (ROE), leverage (LEV) and country-specific variables which are measured through the development of the economy (GDP) (see table 1).

Table 1. Measurement of independent / control variables

Independent Variable	Measurement	Exp. Relationship with ESG Rating	Sources
SUSTEXP	Proportion of directors with sustainability expertise divided by the total number of directors on the board	positive	Ceres (2015)
SUSTLEAD	Dummy variable that is equal to 1 if the bank has a Chairperson or CEO with sustainability profile, 0 otherwise	positive	Alm & Winberg (2016)
WBOD	Total number of women on the board of directors divided by the total number of board members	positive	Arayassi et al. (2020), Rao et al. (2017)
BODIND	Percentage of independent board members divided by the total number of board members	positive / negative	Arayassi et al. (2020), Garas et al. (2017)
BODS	Percentage of independent board members divided by the total number of board members	positive	Birindelli et al. (2018)
SUSTCO	Dummy variable that is equal to 1 if the bank has a sustainability committee, 0 otherwise	positive	Birindelli et al. (2018)
BANKSI	Total assets (Euro) of the bank	positive	Tamini et al (2017), Carter et al. (2010)
ROE	Bank's net income divided by the value of its total shareholders' equity	positive / negative	Setó-Pamies (2015)
LEV	Tier 1 Capital as percentage of total assets (proxy for the Basel 3 leverage ratio)	positive	Helfaya and Moussa (2017)

GDP	Gross Domestic Product (GDP) per capita based on purchasing power parity (PPP)	positive / negative	Fernandez-Feijoo et al. (2014)

3.2 Methodology

The hypotheses have been tested regarding the effect of the independent variables on the ESG rating. Following the methodology of recent research [5,30,31], panel data analysis is used to control for omitted and / or unobserved variables. The choice of fixed effects (with respect to random effects) model can also partly mitigate endogeneity issues (Woolridge, 2014).

Natural logarithmic transformations of the numerical (non-index) variables of the board size, GDP and bank size have been performed to better approximate a normal distribution and overcome a possible problem of heteroskedasticity [30]. The OLS fixed effects regression model is estimated as:

$$y = \beta_0 + \beta_1 X_{i,t} + \varepsilon_{i,t}, \; t=1,2,3,4,5 \qquad (1)$$

where y is the dependent variable, the ESG rating, β_0 is the constant, the variable X, e.g., the variables of interest, are the different board characteristics as per table 1, ε is independent disturbance, i stands for the individual bank, and t stands for the years covered by the data sample.

Following previous research [5,7,18,34] the OLS fixed effects regression model is complemented by a Hausman's specification test to test whether X is a truly endogenous variable [37]. The respective 2SLS regression model is estimated as follows:

$$x = \alpha_0 + \alpha_t A + \varepsilon_i \qquad (2)$$

where x is the dependent variable, the ESG rating, α_0 is the constant, the variable A, the different board characteristics as per table 1, ε is independent disturbance, i stands for the individual bank, and t stands for the year covered by the data sample.

4 Results

4.1 Descriptive Statistics

Table 2 shows the descriptive statistics for the dependent and independent variables. The descriptive statistics include the mean, standard deviation, the minimum and the maximum. The mean of ESG ratings of the banks in the sample is 63%, with a minimum of 29% and a maximum of 88%. The average ESG score is in line with previous research [30]. Sustainability expertise on boards shows a mean of 13% and a maximum of 57%, which is a rather low value. Sustainability leadership, e.g., a CEO or Chairperson with sustainability experience, exists with a rather low number of 12% of the companies in average. The share of woman on boards and the proportion of independent directors on boards stand at 30% and 62%, respectively. The share of woman on boards remains rather low but seemed to increase compared to previous research findings [30].

The share of independent directors is in line with previous research [30]. In average, 15% of the banks have a sustainability committee.

Table 2. Descriptive statistics for the dependent and independent variables

Variable	Mean	Standard Deviation	Minimum	Maximum
ESG Rating	0.63	0.15	0.29	0.88
Sustainability expertise	12.88	13.29	0	57.14
Sustainability leadership	0.12	0.33	0	1
Woman on the board of directors	30.14	10.87	0	50
Board independence	62.35	24.3	18.75	100
Board size	2.62	0.32	1.79	7.68
Sustainability Committee	0.15	0.36	0	1
Bank size	5.81	1.16	2.89	7.68
Return on equity	7.81	10.72	-26.18	106.9
Leverage	8.49	8.18	3.61	43.07
GDP per capita, PPP	10.76	0.21	10.46	11.40

4.2 Correlation Results

Table 3 provides a pair-wise correlation matrix showing important relationships between the main independent variables of the study. A multicollinearity problem usually arises when the correlation between two variables exceeds 0.9 [5]. In this correlation matrix the highest correlation measured is between bank size and leverage. Therefore, we can conclude that we have no problem of collinearity [35]. The relationships show that more women on the board and the existence of a sustainability committee are associated with higher levels of sustainability experience. In addition, the existence of a sustainability committee is associated with sustainability leadership.

Table 3. Correlation matrix

Variable	SUSTEXP	SUSTLEAD	WBOD	BODIND	BODS	SUSTCO	BANKSI	ROE	LEV	GDP
SUSTEXP	1									
SUSTLEAD	.094	1								
WBOD	.260**	-.175	1							
BODIND	.218*	.021	.132	1						
BODS	-0.403**	.057	.134	-.49**	1					
SUSTCO	.510**	.185*	-.035	-.058	-.141	1				
BANKSI	.178*	-.146	.309**	-.360**	.407**	.079	1			
ROE	-.083	-.079	.067	.122	-.032	-.032	-.093	1		
LEV	.202*	-.101	-.161	.108	-.466**	.416	-.592**	.038	1	
GDP	-.056	-.263**	.119	.228*	-.119	.057	-.088	.008	-.073	1

[*** p<0.01, ** p<0.05, * p<0.1]

The result of the fixed effects regression is presented in table 4. The results show that one of the independent variables of primary interest, sustainability leadership, is statistically significant at the 10% significance level. Sustainability expertise is not statistically significant at none of the significance levels. However, it shows that there is a significant negative relationship between the board size and the ESG rating. This contradicts previous research, where a positive relation between board size and ESG performance was found [30]. A non-significant negative result has been found for the share of independent board members current result, where current findings are inconclusive [30]. A negative relationship was found by Walls et al. (2012), Hannifa and Cooke (2005) and others [30].

Table 4. Fixed effects regression results

Variable	Regression Coefficient	Robust Standard Error
SUSTEXP	.118	.160
SUSTLEAD	.095*	.054
WBOD	.163	.163
BODIND	-.050	.079
BODS	-.117*	.063
SUSTCO	.007	.42
BANKSI	.013	.024
ROE	.001	.001
LEV	.003	.003
GDP	-.220**	.093
Constant	2.974***	1.073
R-squared	.519	.130
Regression Model	1.140***	1.392

[*** p<0.01, ** p<0.05, * p<0.1]

The result of the Hausman's specification test shows an R^2 of .1725, an F-value of 4.6375 and a p-value of .0019. Regression coefficients for SUSTEXP and SUSTLEAD of .411 (standard error .133) and .129 (standard error .067) with statistical significance at the 1% and 5% level, respectively.

5 Conclusion

The fixed regression model and the Hausman's specification test show a significant relationship between the variable sustainability leadership and ESG rating. In addition, the Hausman's specification test, shows a significant relationship between sustainability expertise on boards and the ESG ratings from Thomson Reuters Datastream.

In summary, data based on the sample of EURSTOXX 30 Banks and Thomson Reuters Datastream could reveal that sustainability expertise and sustainability leadership

positively impact the ESG rating of the banks. While these results are based on a sample of the largest European banks, results are limited to those and need to be interpreted in this context.

Further studies might consider to including additional ESG rating data providers, such as Morningstar (Sustainalytics), Bloomberg, S&P given the different ESG rating methodologies applied by the before-mentioned agencies. The company sample might be expanded to additional banks in Europe and to more high-risk and lower risk sectors and industries, in order to gain a broader picture and an understanding if a hard law or a soft law on in the European Union would foster sustainability in European firms.

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The Smart City: Analysis of Application Areas and their Potential in an International Context

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Abstract. With the continuous growth of the world's population, increased pollution levels, global warming, resource scarcity, lack of physical and social infrastructure, hyper-urbanization as well as changes driven by the fast-advancing technology sector, there is a need for fresh input to the strategic development of cities. In the battle for cost-effectiveness and ensuring environmental stability, it is of utmost importance that cities alter their strategies and approaches to achieve higher efficiency in all domains. This study includes the identification of a smart city's application areas and will investigate whether they work in practice in a cross-country comparison of smart cities. A best practice framework that includes successful smart city application areas and their potential including a holistic strategy is provided based on a solid literature foundation and validated by empirical research. The findings of this research suggest that a holistic strategic approach of a smart city's application areas contributes to achieving its maximum potential through a government that not only makes data publicly available, but also sets the right framework for modern business models, and thinks comprehensively to deploy resources where they are most needed.

Keywords: Smart city definition, Urbanization, Smart city application areas, Smart city best practice framework.

1 Introduction

The world's population is growing fast and by 2030 there will be approximately 8.5 billion people on this planet, representing a rise of ten percent over twelve years [1]. The future is urban and hence, it is assumed that ten years from now, almost two-thirds of the world's population will live in cities. Today, 55% of the world's population lives in cities [2]. In 2018, three times as many people from less developed regions were estimated to live in cities compared to more developed regions; 3.2 billion versus 1.0

billion [2]. The sustainable growth of the economy, society, and the environment leads to higher long-term growth of cities. This is due to a set of reasons; for instance, more births than deaths in urban areas; migration from rural areas and from abroad to urban areas; and the development of rural areas into urban areas [3]. Urbanization, however, has brought positive aspects, inter alia, poverty reduction, economic growth, technological and other innovations, a skilled workforce because of better education, gender equality, and participation [4].

Cities are among the most prominent players in generating economic growth. People foster innovation along with wealth. While only two percent of the planet's surface is occupied by cities, they are responsible for seventy percent of global CO_2 emissions. Increasing urban growth is accompanied by an unequal consumption of physical and social resources. Cities rely heavily on traditional systems to provide resources – which is unsustainable in the long-run.

Further challenges that are faced by the world and more specifically by cities include people that need to be moved around and need to be safe; housing that ought to be available for everyone; measures which must be taken to combat unemployment; as well as energy supplies that must be secured, and environmental problems that ought to be tackled [5]. Furthermore, the acceleration of high-technology innovation continues and leads to faster, better, and cheaper products [6]. Undoubtedly, digital transformation triggers changes in entire industries as well as societies [7]. Therefore, it is not only governments and businesses that need to respond adequately, but also cities.

This study aims to understand the organization of smart cities that apply new solutions because of the significant demographic shift and urbanization. This study focuses on the constitution as well as the application areas of successful smart cities. Moreover, it tries to identify these cities' leverage drivers, their views on a holistic strategy and how they can reach their maximum potential.

2 Smart Cities and Villages

The numerous definitions of the term 'smart city' in the literature vary widely. Many definitions include the use of data and new technologies, usually information and communication technologies, as a means to optimize the operational efficiency of a city. The goals are to improve the citizens' quality of life through a well-connected infrastructure along with overcoming environmental challenges and achieving economic growth [8]. A smart city takes advantage of the Internet of Things, a network of connected devices that can communicate and exchange data. The collected data is usually stored in the cloud – in other words, it is connected with the internet. As a first insight, it can be said that the Internet of Things and data analysis support a city in the evaluation of their improvement potential [9].

The fact that there is neither a universal definition for the concept of a smart city nor a single template of it leads to confusion [10]. Another factor of possible confusion is the usage of other similar terms, such as a digital or intelligent city. A so-called digital city focuses on technological features. A digital city's concept aims to create the basis for interaction and sharing of people's experience and knowledge as well as creating

public spaces on the internet for residents and visitors [11]. An intelligent city, on the other hand, primarily comprises of functions of research, technology transfer, product development and technological innovation as a hotbed of innovative industries [12]. It uses top-down approaches with a focus on technology [13]. For an intelligent city to become a smart city, the aspect of people must be added.

Furthermore, there are smart villages. A village consists of one or various human settlements that create a community. The community uses innovative solutions to improve its resilience while leveraging local assets and opportunities. Active participation of the community is needed to develop and implement the strategy of improving their economical, social, and environmental conditions with the help of digital technology [14]. Many human resources can be found in every village. Using them efficiently can bring significant benefits. The impact of information and communication technologies in a small city's traditional life is likely to be greater in terms of the domestic economy as well as social life [15]. In a digital village, technology is integrated into the everyday lives of citizens as they are provided with digital solutions and services [16]. Smart villages are also self-sufficient as well as sustainable [17].

Moreover, urban growth and the indispensable economic growth of a city prompt governments to act more environmentally friendly and use fewer natural resources. A green city is predominantly characterized by its environmental performance, to maximize social as well as economic benefits [18]. Overall, as some definitions focus only on environmental aspects, others include socio-economical, environmental and infrastructure elements, policies, information and communication technologies [19].

The components of a smart city as identified in the literature provided input for the questionnaire for field research. A definition of *smart city* validated by research will be provided in chapter 4.2.

3 Research Methodology

This research seeks to identify the contribution of a holistic strategic approach of a smart city's application areas to reach its full potential in an international context. Given the study's explanatory nature, a qualitative method will be employed through semi-structured interviews, supplemented by secondary data. A deductive approach to theory is adopted since it is based on existing literature. The analytical technique that will be applied is pattern matching logic [20-23]. To achieve data triangulation and thus, strengthening the construct validity of the research, four interviews per case, i.e., per smart city, were completed.

The paradigm of postpositivism appears as the sources, as types of data and theories are diversified and thus, triangulation is created. In the critical theory, the objectively analyzed data is transferred into a comprehensible way; however, it cannot be ruled out that a subjective view, shaped by the researcher's reality, influences the presentation of the results. The context is significant. Therefore, constructivism occurs in the present study. Furthermore, a participatory approach takes place while conducting interviews with experts from the cities under research [22, 24-26].

The method selected is case study because of the research question's character along with the lack of necessity of control over behavioral events; and the fact that the focus of the research is on contemporary events [20]. The qualitative case study research design chosen is a multiple-case study with the same context and theoretical replication logic and a single type of embedded units of analysis. The context is the smart city's holistic strategic approach in order to reach its maximum potential based on the analysis of three analyzed cities. The replication logic is theoretical because the cases are expected to reach distinct results due to different starting positions and approaches. The qualitative method, or the constructivism paradigm [13], will be applied due to the aim to gain in-depth insights into specific cases as well as for contextualization [26]. The embedded units of analysis are constitution, active domains, and leverage drivers.

Independent rankings from 2019 of smart cities [27-29] were utilized in order to identify the three most successful smart cities. Based on these rankings, the top three cities (and those analyzed in this study) were London, Singapore, and Vienna. Four interview participants per city (i.e., P1 to P12), based on their relevance of job titles to the study, were interviewed (Table 1). Given the location of participants in multiple countries, the interviews were conducted via online conferencing platforms between July and September 2020. The interview questionnaire was based on the key concepts identified in an extensive literature review. The average length of the interviews was 52 minutes with the shortest being 37 minutes and the longest 95 minutes. The majority of the results is compatible. However, a difference in the cities' focus was observed: London's emphasis is on digitalization through data and collaboration; Singapore stresses the importance of technology; and Vienna puts sustainability at the center. The interviews, although small in number, provided a rich and comprehensive insight.

Table 1. Interview participants.

City	Participant	Function	Organization
London	P1	Chief Digital Officer	London City Hall
	P2	Lead for Energy Systems	Greater London Authority
	P3	Transport Engineer	Consultancy firm
	P4	Industry Principal in Mobility	Frost & Sullivan
Singapore	P5	Technology Solution Provider	Center for Pioneering Cities
	P6	Government Relations Manager	Autonomous vehicle firm
	P7	Consultant in Technology	Consultancy firm
	P8	Head of Energy Innovations	Commercial firm
Vienna	P9	Consultant for City and Sustainable Planning	Consultancy firm for innovative cities
	P10	Deputy Office Manager and Consultant for Urban Planning	Office of the Vice Mayor (City Councilor for Urban Development, Transport, Climate Protection, Energy Planning and Citizen Participation)
	P11	Head of Innovation	Consultancy firm (mobility solutions)
	P12	Head of Smart City	Urban Planning and Development

As previously mentioned, data collected from this study was analyzed through the analytical strategy and technique of pattern-matching logic. Causal inferences were created based on comparisons of patterns established prior to the data collection with patterns yielding from the findings [21, 23]. Each case was analyzed on its own with specific analytical generalization. In a second step, the empirical patterns that emerged across the cases were compared. Similarity and difference across the cases based on the theoretical foundation (e.g., secondary data) were again compared to the empirically generated cross-case patterns. Further patterns were concluded from juxtaposing as well as cross-case analysis of the interviews. The application of these approaches aimed at developing internal and external validity [20, 22].

4 Findings

The analyzed cities differ heavily in various aspects. The population in London, for instance, is 8.96 million [30] whereas Singapore has a population of 5.64 million [31] and Vienna 1.9 million [32]. However, they all have a migration rate between 29.1-35.7% [33]. Singapore has the highest population density but the lowest unemployment rate [31] whereas Vienna has the lowest crime rate but the highest unemployment rate [34].

Even though the three cities differ with regard to their size, culture, etc., they have many points in common in regard to understanding the concept of and being a successful smart city.

4.1 Constitution

The research identified two commonalities in the constitution of the three smart cities. The first similarity is the role of government: It is crucial in the process of building a smart city, such as the planning of a citizen-centric strategy, adapting regulations and laws for modern business models, distributing resources fairly, and improving infrastructure, where necessary. Hence, it is not about the political structure per se, but rather about the action of the government to create the right framework for the city to develop into a smart city and be able to prosper. The second commonality is the strategy itself. There must be an overarching smart city strategy that includes long-term goals to guarantee that every domain is working towards the same objectives and that financial resources are directed appropriately [21, 35-36]. For the reason that the strategy includes the city as a whole, it has to be holistic [27].

Moreover, the cooperation and collaboration between the departments can be widened and strengthened thanks to such a goal-setting elaborated strategy [36]. Research shows that success factors in building a holistic smart city strategy is the presence of a project team and the definition of realistic goals [36-37, 40-41, 44-46]. Only with a solid strategy, a city can embark on its transformational journey to become a smart city.

4.2 Application Areas

A smart city's main application areas that derived from the literature and were validated by the field research are holistic strategy, government, technology, data, infrastructure, citizens, mobility, education, health, environment & sustainability, quality of life, and economic development. According to the fieldwork, the government is the most important application area, followed by citizens, data, technology, and environment and sustainability. Four cohesions result from the fieldwork, namely data, innovation, government, and mobility.

An in-depth literature review combined with the examination of the empirical results led to the following definition of a smart city: *A smart city follows a governmental developed data-based holistic strategy that focuses on investments in technology, infrastructure, healthcare, and education, which in turn fuels innovation and sustainable economic development in an environmentally friendly context, resulting in high quality of life.*

4.3 Leverage Drivers

Four leverage drivers were identified in all three cities that enable a smart city to take advantage of its full potential. The first leverage driver is data. In all cities, data is publicly available. This helps to increase the public understanding of the city's activities and it further boosts the innovation and start-up sector [36-37, 40-41, 44, 47]. The second aspect is the inclusion of a holistic strategy. By establishing a comprehensive strategy, the collaboration of departments is almost guaranteed. The strategy serves as a reference point not only for the government and the departments but also for other stakeholders such as the citizens. It is important to monitor the strategy and to adapt it, if necessary. This also supports the notion that the city can further develop sustainably. Thirdly, another area in common is mobility. London, Singapore, and Vienna have advanced mobility systems. This is an important driver as it enables flexibility at the same time as reducing traffic. There are many other benefits to smart mobility, including safety, connectivity, reliability, cleanliness, convenience, fewer emissions, and less time consumption [36- 43, 48]. The last leverage driver that can be identified in all cities is citizen-centricity. It is crucial to put the citizen at the center; social inclusion should be the primary goal of a smart city. It is vital to involve citizens to create a better quality of life for them. High quality transport services for the public, disruptive technologies that allow citizens to be involved in decision-making, an advanced healthcare system, and sustainable solutions are only some examples of how the smart cities analyzed engage their citizens [35-46]. By combining and implementing the first three leverage drivers, it is crucial to focus on the fourth leverage driver 'citizen-centricity' to ensure their receptivity amid changes.

4.4 Potential

The evaluated responses of the interviewees revealed that data are essential to reach a city's full potential. Without data, a city can neither develop professionally nor sustainably [35, 38, 44]. It is important to focus on the big picture and then prioritize [26].

Plan and set goals, monitor them and act accordingly [37, 40-41, 43]. A holistic strategy is a "must" for a city that aims to become a smart city and in order to reach its maximum potential [39, 41-43, 45].

Furthermore, a government should have laws and policies which are business-friendly, as well as development plans that boost the overall progress of the city [38-40, 45-46].

International exchange is important for benchmarking and for adapting the strategy so that the city ultimately reaches its full potential [40]. The significance of interactions is tremendous as cities can help each other, and simplicity should be embraced as there are already many great innovations just waiting to be used [36].

4.5 Holistic Strategic Approach

With a holistic strategic approach, goals become understandable to all stakeholders, and it will be easier to collaborate. It is also recommended to provide sub-strategies for each sector with more detailed targets. A holistic strategy also assists to direct financial resources accordingly and to assign the funds appropriately to the relevant domain [36-37]. Finally, the topics that shall be covered by a smart city strategy include design thinking, data handling, open innovation, and technology usage [37].

The holistic strategy should have long-term goals to allow cooperation and collaboration between the various departments and municipal companies. Contrary to sectoral strategies that include short-term objectives that help to promote, support and implement into a certain area [36].

4.6 Strategy Replication

Reviewing a strategy or parts of from other cities can help to benchmark, to obtain a better understanding of good practices as well as to adopt and adapt the current strategy, but not for replicating the same strategy [37, 45, 40]. Because every city is different, it is therefore difficult and nearly impossible to replicate a strategy [41]. Cities with similar prerequisites can copy strategies, however, adjustment is always necessary as "no one size fits all" [38].

The digitalization of data and their usage to improve the infrastructure (as derived from the fieldwork) is an area that can be replicated more easily. The city of London has five principles that are most likely replicable in different cities [44]:

1. Design: Things should be designed better according to principles.
2. Data and connectivity: It should be thought about how data is shared to solve problems effectively.
3. Fix the plumbing: The infrastructure ought to be up to date before going a step further.
4. Talent: People's and society's digital maturity, as well as a strong labor market, are key.
5. Collaboration: Institutions that are right to collaborate with others and that form links need to be ensured.

For a city to replicate a strategy and to transform itself into a smart city, many obstacles must be faced, such as a city's political structure and the financial situation [35, 39, 42].

5 Best Practice Framework

As mentioned previously, every city is very distinct. Nevertheless, the conceptual framework allows derivations that led to a best practice framework which was validated by the field research (Fig. 1). There are three main parts, namely enablers, goals, and results.

The enablers can be seen as the foundation of a smart city. The four dimensions that enable a smart city (a holistic strategy, data & technology, infrastructure and citizen-centricity) to reach its maximum potential are closely interlinked and mutually reinforcing. Without this group, it is nearly impossible to build and sustain a smart city. The basis of the enablers is the holistic strategy. Field research identified that without a solid strategy, the city lacks a roadmap, it is running the risk of duplicating work, and it becomes very difficult to achieve the desired result. Data & Technology help not only to establish the strategy but also to monitor and improve it. In addition, infrastructure is viewed as an enabler since it is a key element of a city. The engagement of citizens is indispensable when implementing the strategy because they need to be involved and motivated for change. Only when these four components are established, the smart city goals can be achieved.

The four main goals include education, mobility, innovation, and health. These four pillars should be managed smartly. The fulfillment of these goals leads to the earlier defined results. One of the results is environment & sustainability. A smart city should be environmentally conscious and function sustainably. Furthermore, economic development is important as it provides employment and business which are both necessary for a city to operate and finance itself. And lastly, a higher quality of life – not only for citizens but also for visitors – is the greatest result that should be aimed to be achieved as a city is built for its citizens.

The framework is shaped by the government and its institutions, as both the literature and field research provided evidence for the important role it plays. Government needs to set the right framework and goals for the particular city that include appropriate laws and regulations that allow a transformation of the city. Also, the international exchange between the smart city government and other countries and cities can support the transformation. Not only innovation, but also ideas, experiences, and issues can be discussed and shared in order to help each other in the improvement of cities. Since international exchange is not a mandatory element, it is delimited with a dotted line from the core part of the presented framework.

A smart city's concept is comprehensive, as presented in Figure 1, and with all of its components validated in the field research. The focus, however, differs from one city to another, depending on various elements such as the progress of their transformation, citizens resistance to change, the political situation, financial position, etc.

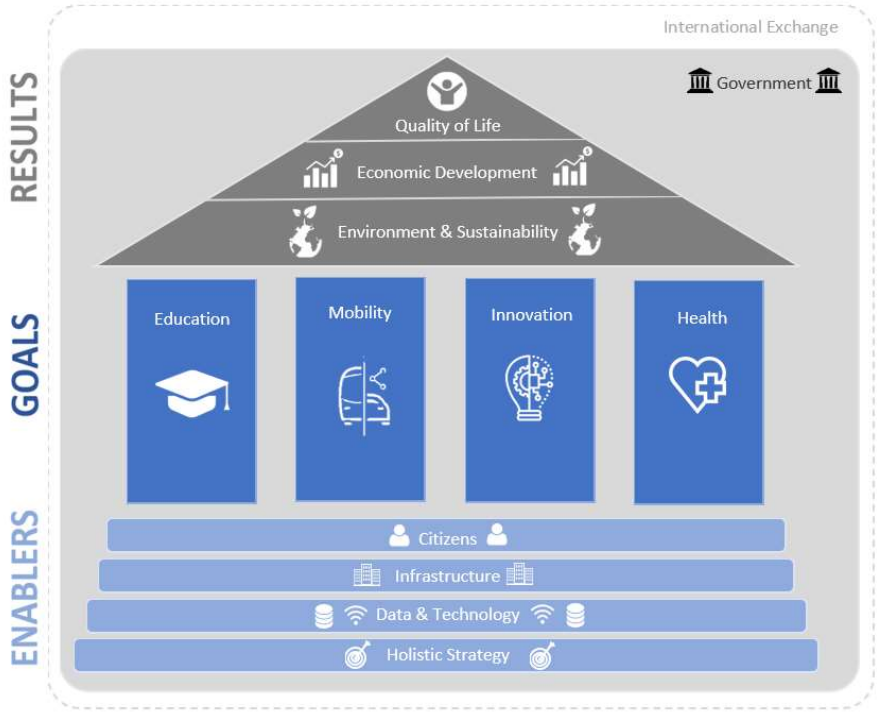

Fig. 1. Smart City Best Practice Framework as derived from the research.

6 Discussion and Conclusion

The research identified two aspects of a successful smart city's constitution. Firstly, the government's fourfold role: Government institutions are strategic planners and with this, they should put their citizens in the center of their activities. The second role is as a framework setter: Government institutions create the right framework for the city's prosperous development, including business-friendly laws and regulations including contemporary business models and support for start-ups. Thirdly, it is dealing as a resource allocator as it plans a fair distribution of resources to all stakeholders. Lastly, the government's role as a renovator includes the renewal of infrastructure wherever necessary.

The second commonality of the smart city's constitution is an overarching strategy that includes long-term goals. Having a holistic strategy facilitates the understanding of all stakeholders and removes the risk of work duplication. Both elements are mentioned multiple times in the literature. This emphasis has been confirmed with the findings from the collected research data.

Regarding the application areas, there is cohesion in four of them. The first includes data storing and harmonizing and to make them publicly available. Secondly, the application area of innovation because of open data availability which fuels innovation.

The third application area, government, is congruent to the results of the commonalities regarding the constitution of a successful smart city. It is important as it plays a key role in creating the right parameters for the city's transformation into a smart city. Lastly, the domain of mobility because it plays an important role as a promoter to flexibility and efficiency.

The results from this research imply that a strategy determines the use of resources, anticipates and evaluates risks and shows the willingness to act in order to achieve set goals. A solid strategy is indispensable for a smart city to be successful. This emphasis has also been confirmed with the findings from field research. The concept of a smart city is holistic as it touches many different fields. Therefore, it can only be implemented with a holistic approach. A holistic strategy includes all application areas of a smart city, and it should be broken down into levels, inter alia, the local district government, and the public. Through this methodology, interdepartmental collaboration is enhanced, and resources can be allocated accordingly.

The findings from this research project suggest that four main factors explain the way a holistic strategic approach of a smart city's application areas can contribute to achieving its maximum potential:

1. All-embracing thinking: it will foster collaboration and promote innovation;
2. Government decisions: it will establish laws that create the right framework for modern business models including start-ups;
3. Resources distribution: it allocates resources where they are most needed; and
4. Making data publicly available: it provides transparency and fosters new ecosystems.

However, a smart city requires the workforce which has the capacity and skills to plan and implement a contemporary city that focuses on education, mobility, innovation and health. It requires vision, dedication and in many cases the financial ability to establish a smart city. Further research is recommended to understand the differences between the enablers, goals and results of a best practice smart city and those who are not yet that advanced on their transformation journey. It is suggested that research shall measure the maturity levels of constitution, application areas and drivers to build a better understanding of the success factors of city transformation.

With the identified and described Smart City Best Practice Framework, a reference point and navigation aid will support governments in the pursuit of their holistic strategies to advance their cities in the digital age.

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Adopting AI in the Banking Sector – The Wealth Management Perspective

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Abstract. While interest in understanding the impact of Artificial Intelligence (AI) in the real world has been growing, there is limited research on what digital transformation means in the banking sector. The present paper aims to address this gap in the literature by means of a field study based on 11 interviews with wealth managers from across front, middle and back offices in a large Swiss bank. Our analyses suggest bank employees have relatively positive attitudes toward the adoption of new technologies. According to the research, the top three advantages for adopting AI in wealth management are: efficiency, enhanced clients' experience and better customer insight. Yet, AI also brings new challenges to banking. Obstacles identified include process complexity, greater maintenance effort, and increased regulatory requirements. Still, AI is expected to change the banking model to an integrated, hybrid and leaner operation with digital processes that offer front-to-back solutions. With respect to the future of the bank workforce, hiring tech-savvy talent will be crucial. AI will be able to free bank employees from repetitive jobs for more interesting and creative tasks.

Keywords: Artificial Intelligence (AI), Banking sector, Wealth management.

1 Introduction

Since the world entered the Industry 4.0 phase, digital strategy in the financial sector has become a critical element for banks looking to maintain sustainable growth and competitiveness. The application of communication technologies, AI and robotics in banking industry requires different competencies from managers [1]. The clients of today demand better banking experiences in terms of speed, price and digital connectivity. Millennials, who are seen as digital natives, are expected to soon become the largest client population for banks. Therefore, private banking and wealth management have undergone a fundamental transformation through the introduction of AI and financial technology (FinTech).

With the increasing popularity of AI across all industries as well as in the consumer's daily life, there is growing interest in conducting research on the social and ethical dimensions of AI [2-3]. The opinions collected are mainly from either the digital technology provider side, or the consumer side. Based on empirical studies, researchers have identified what drives consumers who are early adopters of FinTech

products [4]. A more recent study conducted by Aitken, et. al (2020), done with a wide range of focus groups that included diverse members of the public, shows that AI in the banking sector can be a double-edged sword. The focus groups appreciated the benefits of AI enhanced services but had concerns about the negative impact of AI on society [5]. While the key to success with AI is human-machine collaboration [6], so far research has largely overlooked the perception of AI from the perspective of bank employees, who have seen their everyday functions change dramatically. The present study addresses the gap in the literature through qualitative research at a large bank. Our rationale for choosing the wealth management business unit to provide the research context is two-fold. First, AI is expected to play a crucial role in wealth management in the future [7]. It is therefore essential to understand how AI is going to change the wealth management operation model. Second, but equally important, is to analyse how wealth managers and the rest of the banking workforce perceive the opportunities and risks of using this new technology, as the application of AI can only reach the potential of its full advantages if it is accepted and welcomed. The objectives of this research are to understand the impact of AI on the wealth management operation model and identify the key opportunities and challenges for the banking workforce. To this end, the findings of this study will contribute to the current literature of our understanding of how and why a new technology is perceived to be useful. For practitioners, the study results are evidence of certain potential applications of AI in the banking sector in general, as well as the implications for wealth management in particular.

In the next session we will briefly review the general operation model of wealth management, discuss the impact of digitalization, and look at several AI use cases in the banking sector. Thereafter, we will describe our research design and method. In section 4, the field research results will be presented and analysed. In the final section, we will summarise our research findings, highlight the limitations of the present study, and outline future research avenues.

2 Wealth Management and the Use of AI

Until about 20 years ago, the 200-year-old wealth management industry had been growing steadily under pretty much the same operation models. Since the financial crisis of 2008–2009, the financial services sector has been under growing pressure to adapt to fast-changing business environments, demanding client needs, higher expectations of shareholders and new regulatory requirements. More recently, wealth managers have experienced considerable headwinds. In 2018, global high net worth grew only by 4%, quite low compared to previous years. Because of lower growth in assets under management, increased fee pressures and volatile markets, the business valuations of wealth management firms dropped by more than 20% in 2018 [8]. Furthermore, higher regulatory requirements have led to more focus and resources directed toward risk and compliance. In essence, moderate economic growth, increased emphasis on risk and regulation aspects, and higher capital requirements have affected the traditional operation models of wealth management [9-10].

Wealth management, in general, is defined by the provision of financial advice to clients with respect to maintaining, transferring and enhancing their wealth. The typical business comprises core banking services, including liquidity management, lending products, brokerage, and financial and non-financial advisory in fields such as real estate, commodities, alternative investments, offers of discretionary and advisory mandates and wealth planning [11]. The bank's wealth management operation model is usually divided into three organizational units: the front, middle and back offices.

Traditionally, banks have focused on introducing various independent initiatives within each unit, with the aim of improving efficiency and performance [12]. The result of this practice is the duplication of efforts and recourse redundancy. Since the front office contributes to more than 50% of overall costs, to increase efficiency, processes automation of front office operations can enable advisors to spend more time on clients to generate revenue [8]. In fact, applying a digital business model can automate processes across the front, middle and back offices [13]. This will lead to the simplification and the optimization of processes, enabling cost reductions for the bank and increased focus on value-adding tasks for the employee. However, in the short term, this requires upskilling the existing workforce, hiring tech-savvy employees and implementing new technologies [14].

AI is a set of technologies that has the power to make predictions and anticipate future events, including autonomous learning, as well as recognize patterns, make good decisions and communicate with humans [15]. Facilitated by the falling costs of data storage and the increasing speed of connectivity, the banking business is already in the AI-powered digital age. According to a McKinsey report (2020), annually AI can potentially unlock $1 trillion in incremental value for banks [16]. Often cited use cases where AI is applied in the banking sector include:

Credit Scoring. AI is used to improve standardized credit scoring processes. In the past, most banks assessed their credit ratings based on the lender's payment history. Today, banks use data sources, such as mobile phone usage or social media activity, to assess creditworthiness and achieve more accurate loan ratings [17]. Customer data and credit history are also analyzed through a system that applies machine learning algorithms for quicker credit decision-making, thus reducing a bank's default risks and providing higher quality assessment [18].

AI–powered Fraud Detection. AI is also used for better risk management by using machine learning and huge data points for fraud detection, which leads to a more accurate and earlier estimation of risks [17]. Through risk-forecasting and anti-fraud models, banks can benefit from better control over and anticipation of fraud risks [18].

Robo-advisory. Based on market data, such as client investment preferences, risk appetite or age, robo-advisory provides automated advice to fulfill clients' needs and reduce the bank's staffing costs [18]. However, since robo-advisory is a novel phenomenon in the wealth management sector, it is relatively unregulated, and thus cost transparency and information on consumer protection are lacking [19]. In addition, protecting client information and cybersecurity are very important when offering automated online advice [20-21].

Personalized Offerings and Client Retention. A popular AI use case among younger generations is virtual agents such as chatbots, which enhance customer service

by the automation of simple requests [17]. Clients benefit from a personalized banking experience, with 24/7 online banking access and the opportunity to interact with chatbots at any time, independent of time zone [22].

Regulatory Compliance in the Financial Sector. Regulatory technology (RegTech) is another high potential area for AI development, such as the automation of Know-Your-Customer (KYC) and anti-money laundering, where the entire onboarding process can be streamlined [23]. The KYC process is often time consuming, labor intensive and costly. Through machine learning, pre-checks on background information can be automated, and ongoing periodic reviews can be performed using other public data sources, such as official registers [17].

According to research from Narrative Science, 32% of financial services firms already use AI technologies, such as voice recognition or predictive analytics [24]. In fact, UBS, a Swiss multinational bank with global largest wealth management, has already numerous robots in place and several processes were already automated. As early as 2016, it has carried out a number of active AI-enabled intelligent automation pilots. Furthermore, UBS has also been exploring how to combine behaviour finance and data science to identify and remedy behaviour biases in the investment process [25].

3 Research Design and Method

One of the often-referred research models for the spreading use of new technology by individuals is the technology acceptance model [26]. According to the model, two factors influence the adoption of technology: perceived usefulness and perceived ease of use. The perceived usefulness is the expected user's subjective estimation that using a particular application system will improve job or life performance, whereas perceived ease of use is defined how much the user expects that a specific system is easy to use and free of effort. Since the focus of our research is to examine how AI adoption in the banking sector impacts the operation model, which also influences work behaviour from the perspective of wealth management, we have selected the perceived changes in operation model as the dependent variable. Furthermore, we investigated how the future of the workforce may look like in an AI-powered work environment. We extended the technology acceptance model (shown in Figure 1) by taking opportunities as the main variables for perceived usefulness in our conceptual framework. The perceived ease of use includes challenges from technical skills, system safety as well as potential ethical issues. The influence of these two aspects on the operation model of wealth management, which further affects the future of the workforce in terms of employment behaviour and the relationship between the bank and its clients.

Guided by the conceptual research framework, we applied a qualitative research approach. By conducting multiple case studies, each in the same banking context but embedded in different business units according to the wealth management operation model, namely front office, middle office and back office, we were able to collect insightful information for further analysis. Before we contacted interviewees, we conducted a pilot study to test if all the questions we asked were properly understood and if some important relevant questions were overlooked. Based on the feedback from

the pilot study, we modified the questionnaires which were used in the interviews. In the field research, we selected 3-4 managers from each unit at director or higher levels with various responsibilities as our first-hand sources to gain insight from both operation and decision-making processes. We assured the sources that all the information they provide would be treated anonymously. The semi-structured interviews combined with open-ended questions were conducted between March and April of 2020. Due to the pandemic, all the interviews were done via Skype. The average interview last about an hour. The online conversations were recorded and thereafter transcribed. With the help of the software ATLAS.ti. we analyzed all answers from the interviews and generated inductive codes which will be presented in Section 4.

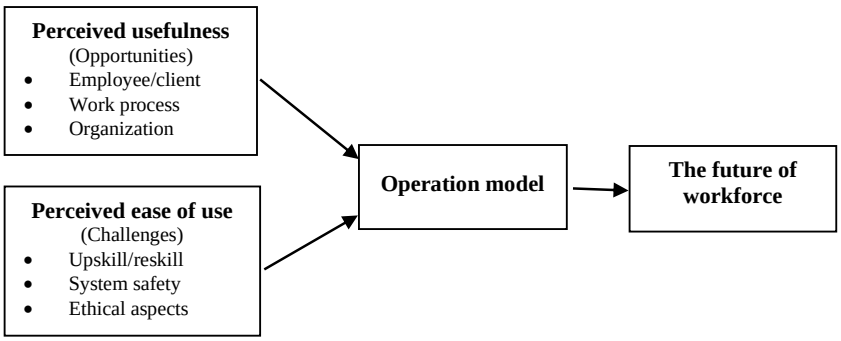

Fig. 1. Conceptual framework of the impact of AI on wealth management (authors).

4 Results and Discussion

This section presents the empirical findings derived from the data collected from the interviews. First comes the within-case analysis for each of the three cases presented, followed by the cross-case analysis, which shows the differences and similarities between the cases.

4.1 Case One: Front Office

The primary activities of the front office include payments, lending and deposits, capital markets, market data and wealth management [13]. Digitizing front-end client interactions and processes can further improve client experiences and reduce costs. Manual tasks, such as client profiling or asset allocation modeling, will be automated, allowing advisors to focus on tailored offerings, advising their clients, and conduct client development [27]. In the bank where we conducted our field research, AI-powered chatbots, machine learning techniques and natural language processing were already in use in the front office. However, most projects are still in a proof-of-concept stage and not yet live. To improve efficiency, the bank is trying to use AI to automate and streamline processes in client onboarding, by automating checks in existing tools, and

in yearly KYC reviews. Based on the four interviews, we summarize the findings from the front office in Table 1.

Table 1. Summary of key findings based on thematic coding of interviews in front office.

Variable	Key findings
Opportunities	▪ Efficiency (time efficiency for client onboarding) ▪ Client experience and client interaction (through advanced data analytics and better client insights) ▪ Speed (faster execution than humans)
Challenges	▪ Technical complexity ▪ More regulatory requirements ▪ Buzz-wording (discussing AI but no action)
Operation model	▪ AI will lead to a mix of self-directed and human-based models ▪ More integrated, efficient and data driven, offer more tailored solutions ▪ Scalability, close collaboration with middle and back offices are the main requirement for integration
Future workforce	▪ Improved human capabilities enabling employees to focus on more meaningful and creative work ▪ Technical skills are relevant, but for clients the human touch and interaction remain critical ▪ Client-facing roles will be less affected compared to the roles in the middle and back offices ▪ AI can lead to job loss

Our study results show most front office managers are open to adopting AI. This is particularly true for the Millennial generation who enjoy a mix of human and machine in their work. For senior bankers, however, they needed to make more of an effort to catch up with new tech trends and often saw digital transition as a threat. AI should not undermine the importance of '*the human touch and personal interaction with clients*' pointed out by one of our interviewees.

4.2 Case Two: Middle Office

Typical middle office services include trade capturing and settlements, corporate action processing, risk management and reporting regulatory compliance and collateral management [28]. Our research shows that the middle office is clearly focused on robotic process automation (RPA) algorithms, automating simple and repetitive processes such as copy–paste tasks and creating basic reporting. For periodic KYC review, a robot has been built to support the client advisor in performing background checks in the system, one that is connected to the client advisor platform. The research findings from the middle office are summarized in Table 2.

Table 2. Summary of key findings based on thematic coding of interviews in middle office.

Variable	Key findings
Opportunities	▪ Efficiency (process and cost) ▪ Availability (a robot can run 24/7 and has no sick leave) ▪ Speed and scalability (faster)
Challenges	▪ Complexity (business process in wealth management) ▪ Operational risk (ethical risk, uncontrollable outcome) ▪ Maintenance effort (technical and human resources
Operation model	▪ AI will lead to a leaner organization with fewer people as process will be streamlined and automated from front-to-back ▪ Integrated organization with automated process which lead to cost efficiency, higher accuracy, and faster speed to market requirement for integration
Future workforce	▪ Improved human capabilities, more expert roles ▪ Technical skills will be relevant, analytical and creativity competence will be important ▪ Some new jobs will be created while some existing ones will disappear

Feedback from the managers we interviewed revealed that they had a generally positive attitude toward new technology in the middle office. Most employees are open to change and want to develop their skills toward carrying out meaningful tasks and creative work. However, '*The quality, accuracy and reliability of the AI applications must be ensured so that employees trust and accept AI,*' said the manager in the middle office. For AI to succeed at a high level, the bank must have the right workforce, be technologically ready, and provide a stable infrastructure, including proper governance to enable scalability and efficiency.

4.3 Case Three: Back Office

Back office duties include account opening and mortgage loan approvals. As direct interactions with clients are not necessary, back offices are thus usually located in more remote locations due to lower property costs [29]. Traditionally, back office operations have been personnel and paper intensive and mostly conducted manually, because one request may involve several action steps across various departments [29]. Automating back office processes, particularly in operations and risk management, can standardize operations across channels and free up time for employees, which can lead to a 50% increase in client satisfaction and productivity [12]. In the bank where our research was conducted, introduction of investigating robotics and cognitive tools began two years ago, with the focus on basic RPA and automating basic processes using tools such as macros and end-user applications. Thereafter, the focus was on culture change and familiarizing employees with new ways of working. Today, there are several hundred of robots used in operations, most based on RPA. The upcoming evolution will begin with cognitive tools focusing on optical character recognition, where tools can read structured and unstructured text on pages by using natural language processing and chatbots. In

risk management, a robot has been built to run scripts, create and send files via file box to the warehouse. However, it will take two to three years to reach a mature level.

Table 3. Summary of key findings based on thematic coding of interviews in back office.

Variable	Key findings
Opportunities	▪ Efficiency (cost) ▪ Customer insights ▪ Advanced data analytics
Challenges	▪ Risk from fairness and bias (lack of transparency of an AI model) ▪ Risk from interpretability (lack of auditability of an AI model or difficult to explain why a client did not get the loan because of the machines' decision) ▪ Operational risks (ethical risks)
Operation model	▪ AI will lead to an integrated operation model ▪ Focus on 'One Bank' spirit by optimizing front-to-back operation ▪ Back office will be operated by fewer but more highly skilled workers
Future workforce	▪ Improved human capabilities, enable employees to focus on more complex work ▪ Technical skills will be the most relevant ▪ Trend is moving toward hiring data analysts, engineers, and data scientists ▪ Hybrid AI / human workforce, mixed teams consisting onsite and virtual workers

Our takeaway from the back office study (see Table 3) is that thinking along the lines of the 'One Bank' paradigm, having common goals to achieve a more integrated organization, and optimizing front-to-back operations is the key to banking success. Another challenge in the adoption of AI is the lack of technical talent. '*Not only having the right people employed but also having the right infrastructure and a good system landscape in place will be crucial,'* said the head in the back office.

4.4 Cross-case Analysis

According to our results, employees in the front, middle and back offices appear to have generally positive attitudes toward new technologies. Although, a mix of impressions does exist: some feel excited, while others might be afraid to lose their jobs. In general, though, the willingness is there to adopt new tools. In examining the three cases, some differences arise. In the front office, where the focus is on the client, the aim is to use machine learning and natural language processing techniques to understand the client better, get client insights or generate content. Also, digital assistants such as chatbots that can interact with clients for simple client needs play a role. In the middle and back offices, where processes are simpler and more scalable than in the front office, the focus is rather on the automation of simple processes with repetitive tasks in client onboarding or the periodic KYC reviews. While the front office is focused on finding use cases that lead to enhanced client experience and higher sales and profitability, the middle and back offices focus on saving costs and becoming more efficient and agile. To compare:

Table 4. Summary of key findings on similarities and differences between the three cases.

Variable	Similarities	Differences
Opportunities	▪ Efficiency (time, cost) ▪ Enhanced client experience ▪ Better customer insights	▪ Scalability of automation ▪ The extend of AI use
Challenges	▪ Increasing regulatory requirements ▪ Complexity ▪ Maintenance effort ▪ Threat to job	▪ Operational risks ▪ Legacy structure
Operation model	▪ AI leads to a more efficient, integrated and leaner operation model ▪ Front-to-back solutions	▪ Middle office and back office will need fewer workforce but with higher IT skills ▪ Front office will operate in hybrid
Future workforce	▪ Improve human capabilities enable employees to focus on more complex work ▪ Technical skills are the most relevant; upskilling and reskilling will be crucial	▪ Different degree regarding job creation ▪ More diverse roles and workforce

5 Conclusion

The present paper is a study on how AI impacts the banking sector. By means of in-depth qualitative field research on wealth management at a large bank, we identified how AI is perceived by managers with respect to opportunities and challenges. In particular, this research also provides an assessment as to how AI will affect intra-collaboration between front, middle and back offices, and how the future banking workforce will be influenced. In reviewing our research, we can draw some preliminary conclusions based on our conceptual framework as shown in Figure 2.

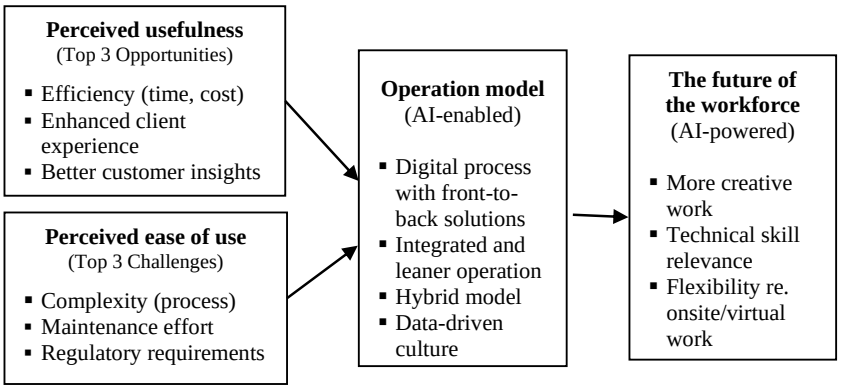

Fig. 2. Applied conceptual framework with key findings from empirical results (Authors).

Wealth management is undergoing a digital transition. The Swiss banking sector has a successful legacy and has proved its resilience over several major crises. However, the Swiss financial sector lags behind key international competitors in terms of digital adoption and adapting to changing business models [30]. Through our analysis, it became clear that bank managers have a relatively positive attitude toward adopting new technologies. Employees also perceive AI as useful if the applications work, the quality of the AI applications is assured, and if they understand how technology helps them to better perform their jobs. AI is meant to create a leaner front-to-back operation process that emphasizes the client's needs. This will lead to a hybrid model, combining self-service to enable clients to access state-of-the-art technologies for basic banking needs combined with human-based high-touch expertise to provide tailored advice. Therefore, AI will create a data-driven culture and only an ethical use of collected data to gain client insights can help offer more tailored solutions and make more accurate risk assessments, which will ensure a sustainable development of the banking sector. From the perspective of future workforce, our study shows AI can substantially free employees from repetitive work for more creative activities. Another advantage of digitalization for the workforce is the flexibility of working remotely. This has best been demonstrated with the pandemic lockdown situation. Without digital means, continuity of the banking business would be in doubt. However, the fear that innovation will cost jobs is justified because digitalization will automate many jobs and integrate what used to be independent units into a whole system. Our research shows that a leaner and AI-powered organizational structure is taking shape, and the crucial factor for the banks will be whether they adopt proactive or reactive approaches to AI.

Though our research findings shed light on how AI impacts the wealth management operation model and the bank workforce, we wish to highlight some of the limitations of the present study. First, our research conclusions are based on 11 interviews from one business area in one bank. To draw general conclusions on how AI is accepted in the banking sector will require more empirical data. Another limitation of the present study is that we did not take organizational culture into account. To what extent the positive attitude toward AI adoption can be attributed to the data-driven culture needs to be further studied. As cross-border banking business becomes more normalized, it is important to keep in mind that if one AI-powered operation model works well in country, that may not necessarily be the case in another national culture and legal environment. Hence, more study on the roles of national culture and leadership in the digital transformation is certainly warranted.

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Collaborative Model-Based Process Assessment for trustworthy AI in Robotic Platforms

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Abstract. The use of robots in combination with artificial intelligence (AI) is a trend with the promises to relieve humans from difficult-, time consuming- or dangerous work. Intelligent robots aim to solve tasks more efficiently, safer or partly more stable. Independent of the domain-specific challenge, the configuration of both (a) the robot and (b) the AI currently requires expert knowledge in robot implementation, security and safety regulations, legal and ethical assessments and expertise in AI. In order to enable a co-creation of domain-specific solutions for robots with AI, we performed a laboratory survey – consisting of stakeholder interaction, literature research, proof-of-concept experiments using OMiLAB and prototypes using a Robot Laboratory – to elicit requirements for an assistant system that (i) simplifies and abstracts robot interaction, (ii) enables the co-creative assessment and approval of the robot configuration using AI, and (iii) ensures a reliable execution. A model-based approach has been elaborated in the national funded project complAI that demonstrates the key components of such an assistance system. The main concepts paving the way for a shift from research and innovation into real-world applications are discussed as an outlook.

Keywords: Robotic, Artificial Intelligence, Model-based Approaches.

1 Introduction

Digital transformation has the potential to create additional value of about 100 trillion $ (in Europe “billion”) in the next decade [1]. Industry aims to capitalize this potential by creating new businesses and improve existing businesses by applying digital technology. Robotic, AI and the corresponding and enabling key technologies like but not limited to edge computing, industrial Internet of Things (IoT), block-chain, Big-Data and

cloud computing introduce huge business-, social- and technology-potentials. In this paper we address the challenge of autonomous, adaptive or even intelligent robotic systems that promise to (a) be active in dangerous or unhealthy environments, hence relieve human worker from unsafe or unhealthy work, (b) transform or optimize business by either introducing a new form of income or by extending, enlarging or improving an existing business model, (c) reduce volatility by not exclusively relying on human power but relying on human power in combination with supporting robots and the capability to shift some of the workflow between humans and robots.

This paper is based on a one-year survey performed in the national funded project complAI with the aim to: (a) Reduce the complexity and the necessary technological background that is required to realise a robotic application, (b) Empower domain-experts and business managers to co-create innovate new robot scenarios, (c) Enable transparent, audit-proof and compliant solutions "by design" that are assessed and approved according security-, safety-, legal-, ethical- or gender relevant criteria.

Our approach was to develop a model-based assessment tool with the capability to:

1. Introduce a model-based approach using business processes and workflows in order to abstract and hence simplify the complexity of a robot implementation.
2. Enrich the model-based approach with assessment-, approval- and reliability- capabilities to support the generation and execution of compliant workflows at robots.
3. Introduce AI that supports or takes over decision making and enables therefore the introduction of adaptive or autonomous systems.

In the second chapter, we introduce requirements. The main findings are introduced in chapter three – the model-based approach, in chapter four – the assessment criteria, and chapter five – the integration of workflows with assessment criteria. Chapter six lists the downloadable results. Chapter seven is a summary with an outlook.

2 Motivation and Use Case Requirements

We started with innovative business models [1, 2] for the hypothetical use case of digital supermarkets, as it enables to (a) identify innovative use cases, without limitations caused by concrete realisation, as well as (b) enable a common understanding with interdisciplinary partners resulting in simplified communication between different technical and professional background as the situation in supermarkets is well known. Based on those high-level ideas we derived concrete use cases like:

- ***Workflow creation and abstraction*** for robots. Workflows, steering mobile platforms and robots via platform-specific interfaces have been abstracted to become platform-independent workflows defining "artefacts of movements". The more abstract a workflow can be defined; the less technical knowledge is needed.
- ***AI for decision making*** for adaptive workflows. An adaptive workflow has the capability to change its behaviour either before execution – in case of "pre-binding" – or during execution – in case of "late-binding" – enabling an automated system.

- ***Legal and business compliance*** of mobile platforms (e.g., self-driving shopping carts) and robot arms (e.g., assembly of products in cold warehouse). This was realised by assessment criteria that have been applied on robot execution models.
- ***Assessment of workflows and AI*** according legal and business compliance criteria. This was addressed by providing a model-based questionnaire system that links aforementioned workflow models – and abstract workflow models – with AI – semantic lifting and inference as well as rule-based decisions – with a questionnaire model that is extracted out of assessment criteria.

3 Model-Driven Robot Applications

3.1 Introduction into Model-Driven Approach

Conceptual models are used to represent the "system under study" – in our case robots – with the aim to reduce complexity and simplify interaction with the real-world.

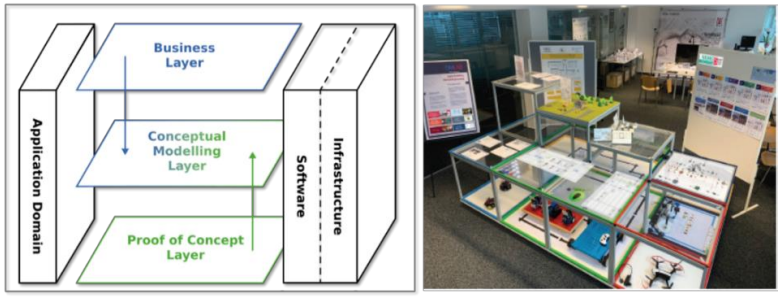

Fig. 1. Introduces the three abstraction layers of the OMiLAB Innovation Corner, of the industrial OMiLAB Innovation Corner at BOC in Vienna is shown in the right part of the figure

We use the OMiLAB innovation corner – introduced above - in order to interlink the (a) business layer that is concerned with creating new business models, (b) the proof-of-concept layer that is concerned with engineering prototypes and (c) the conceptual modelling layer that is concerned with creating organisational models. The OMiLAB Innovation Corner [3] is based on the following principles:

1. **Business Layer:** Focus on Business Model Creation: A business model describes the "rational of how an organisation creates, delivers, and captures value" [4]. The aim is to either improve existing or to generate new business models. This layer therefore provides a high-level overview of the domain, the application scenario as well as the overall eco-system of the organisation. It follows the "Outcome based approach" principle, where digital innovation is always justified by the outcome.
2. **Conceptual Model Layer: Focus on Organisational Model:** Conceptual models are successfully applied in enterprise modelling [5] and information systems [6] and hence capable to describe how the digital solution is applied within an organisation.

The digital innovation is therefore described in a technology independent way using a knowledge-based approach. The knowledge can be interpreted by computer algorithms or by human experts, depending on its model-representation. Hence, we follow the principle to "Invest on use cases and not technology" as the organisational models can be realised with different technologies.

3. **Proof-of-Concept Layer: Focus on Robot Interaction:** Rapid prototyping [7] is "… the idea of quickly assembling a physical part, piece or model of a product". We apply rapid prototyping for both the development of a software application as well as for the development of a physical device. The engineering of rapid prototypes is performed by configuring and integrating pre-packaged features that are provided as services. Instead of fully implementing the prototypes, we apply the "Fail Fast, fail cheap" principle by rapidly composing features in form of services that emulate the main behaviour of the intended solution.

Although the aforementioned layers of the OMiLAB Innovation Corner can be mapped to the three phases of design thinking, "Ideate", "Prototype", and "Test" [8], we explicitly consider that projects either focus on only one or two phases, that phases are visited in no particular order as well as that the phases are worked out in a sequence. In complAI we focused on the proof-of-concept layer mainly, by using workflow models to steer a proof-of-concept robot device in the OMiLAB Innovation Corner and then steer a real-world robot prototype in the robot laboratory.

3.2 Presentation of Workflows for Robot Interaction

The steering of a robot platform hast been worked out in complAI [9] by using workflows that are specified in BPMN notation and that can be interpreted by a series of workflow engines. The concrete movement of a robot, like picking up an object from particular x, y, z coordinates, is implemented as an application interface in form of a method "picking up" with three input variables for x, y and z. This computer program uses platform specific interfaces, in our case these are the dll commands provided by the Dobot Magician, to implement the move of the robot arm to the position x, y, z and start to pick-up the object, in our case to start the suction cup unit with a certain power and a certain amount of time to suck a card that is laying at the corresponding position. All details are provided in the open-source download package [10, 11]. Such a platform-specific command will be exchanged when interacting with the Universal Robot (UR) arm that is used in the laboratory. Hence the movement to pick up an object from a position may be differently implemented but the abstracted move is the same.

This simple sample raises a series of questions like, (a) which tool is used to "pick-up" an object either by grabbing or sucking, (b) is additional information needed for picking and placing like the position when picking and the position when placing, (c) are additional security considerations required like the speed or the power the robot arm moves and the like. Hence, the simple move of an abstract workflow raises several technical and safety relevant questions. In the proof-of-concept environment we aim to free the user from technical questions but focus on issues like picking up an object and placing it. Therefore, we consider this as an "abstraction" to reduce the technical details

and enable the focus on other challenges like, who decides what, when and where something is picked up. In a simple form, we can pre-define a fixed sequence of picking-up items and placing them in a fixed order. In case to make the system adaptive and therefore flexible to react on the situation of the environment, we can introduce a sensor that is checking if a certain object is actually available and hence can actually be picked up, or if another object has to be picked up instead. In the following, we describe a layered software stack for executing workflows on a robotic platform, which is further developed from the work presented in [12]. The individual layers can be described as follows: (a) Robots and drivers: Provide hardware specific drivers for individual robots and additional hardware (sensors, etc.). (b) Integration: Provides modules for integrating the underlying hardware, like full body compliance, sensor fusion or robot motion planning. (c) Workflow abstraction: The workflow manager (WFM) provides an execution engine. The state provider collects information of the individual system components and provides it to all other components. (d) Execution: The WFM-API is a reusable component providing a REST-Interface, which is configured according to the capabilities of the underlying robotic system. In our sample the WFM-API provides methods for executing action sequences like moving the arm to a certain position, relocating the whole platform, or detecting an Augmented Reality-Tag with the camera mounted on the arm's end effector. Similarly, the State-API provides an interface for fetching the current system state from the state provider. (e) User and top-level application: On this layer the user and/or (external) client components can utilize the APIs in order to run or teach robotic applications on the underlying platform.

3.3 AI Integration

The mechanisms to implement and integrate AI in the workflows, are the introduction of adaptive workflows, either pre-binding or late-binding workflows and the introduction of a decision-making component that "binds" the workflow. In our case the "binding" means which values are used for the variables x, y, z, and the decision-making component is either a human who selects which object to pick up next, or an AI component that inferences which object to select next.

In the complAI project, we focused on the model-based aspects and how intelligent decisions related to business [13] can be integrated into the execution models. We based our survey on the assumption that there are tools like image recognition, light-sensors, or weight sensors that can be used to retrieve the necessary information. Our focus was, how to integrate autonomous behaviour in execution models. For that purpose, we propose "decision points" in the execution model, where – potentially – any AI algorithm can be involved to retrieve a decision.

For proof-of-concept purpose, we implemented two approaches in order to decide how to "bind" the workflow. First, we used a rule-based approach following the Decision Model and Notation (DMN) [14] to define "if object a is not available then object b should be taken instead". Such rules can be implemented using a DMN model and the corresponding rule engine that interprets DMN, or it can be programmed in a script, that "if a is not available then object b" should be taken instead. A more sophisticated approach is the semantic lifting of an object with concepts from an ontology. In case

this object is not available anymore, a semantic discovery is performed, and the most similar object is used instead. Those AI implementations are provided by ADOxx.org [15]. The demonstration of aforementioned AI-algorithms is considered as a proof-of-concept for showing how AI-algorithms may be integrated into execution workflows. Other AI algorithms may also be integrated to experiment that decisions are either performed by trusted human experts or by a software. The trustworthiness of such a system needs to be ensured, in particular when robot arms or mobile robot platforms autonomously perform movements that need security, safety, legal and ethical reflection. It has to be stated, that independent of the AI-algorithms a certain security level is mandatory and cannot be influenced by AI algorithms for security reasons.

4 Assessment Criteria

4.1 Criteria on Laws and Ethics

Trustworthy AI has grown to become an increasingly important aspect in the quest for ethically sound and legally feasible AI. This has induced many research areas to start thinking about how to (a) build an AI that is trustworthy, and (b) increase the (justified) trust human users put into these systems. And while there are still considerable challenges, especially related to approaches and understandings of trust and trustworthiness, the overall incentive of this quest is not only important, but necessary.

The complAI project [10] addresses some of the practical and theoretical challenges that arise with the realization and implementation of such trustworthy AI. In this, the main task of the ethics team comprised the elaboration of an applicable ethics criteria catalogue. It is important to emphasize the above-mentioned differentiation between trust and trustworthiness. While human agents already – sometimes irrationally and blindly – trust technologies (e.g., navigation systems), a fundamental question is whether the underlying technology is trustworthy [c.f. e.g., 13, 14]. This aspect is echoed in the main objectives of the elaborated criteria.

We began with a more abstract stance on different notions of trust in AI and trustworthiness of AI. Starting from questions concerning expectations towards technologies, over priorizations and values, to ecological and economical objectives, the ethics team put together a set of important key concepts of different disciplines (e.g., law and engineering) who are engaged in the development of trustworthy AI. Some of these elaborated key concepts included i.a. responsibility, risk, danger, ethical corridor, and AI more generally. Based on these concepts, the emerging catalogue focuses on six pillars: (1) The prisonization of the quality of the technical products over the quantitative propagation, (2) Human dignity, (3) The periodization of social wellbeing over economic benefit, (4) Human-centredness of development of AI, (5) Overcoming negative impacts of factual constraints (“Sachzwänge”) and impossible backward compatibility (“ausbleibende Rückwärtskompatibilität”) so that technological issues do not limit or prefigure human decision making, (6) Risk Management as complex task in technical systems including Robotics and AI.

Those ethical criteria have been refined by aligning with existing literature on trustworthy AI. The catalogue orients itself at some of the key requirements given in the

whitepapers and recommendations by the AI HLEG and the ACRAI. These are: Human Agency & Autonomy, Human Oversight, Technical Robustness & Safety, Privacy & Data Governance, Transparency, Diversity, Non-Discrimination & Fairness, Societal & Environmental Well-Being, Accountability, Responsibility, Values [15, 16, 17]. The survey selected the design- and production-level as experimentation filed at which these criteria could (should) be implemented.

In order to specify ethical criteria that (a) address the mentioned principles and values from the project consortium (especially with regards to the established key concepts), and (b) build on the requirements given by the AI HLEG and the ACRAI, the project consortium devised a case study for showing a potentially dangerous interaction situation between human and robot serving as a foundation for the criteria catalogue [10]. An arising example criterion related to the digital supermarket sandbox scenario could then be formulated as follows: (a) General criterion: "Could the AI system affect human autonomy by interfering with the end user's decision-making process in any other unintended and undesirable way?" [c.f. 25] (b) Case-specific: "Does the system stick to the shopping list of the human shopper? Or can it make suggestions according to the shop's incentives?"

This specific criterion is based on the HLEG's requirement on human agency and autonomy and addresses the value of human dignity. With assuring that the human agent's decision and action process are not interfered by the AI, this criterion aims to ensure that the AI does not affect the human agent's autonomy (e.g., by means of manipulation, nudging, or coercion). This means that the human agent's decision environment is not fundamentally changed by the AI, and that the human agent's decision and action can be understood to be the result of a free and autonomous choice.

Summarizing, the criteria given in the catalogue are, first and foremost, an adaption of the criteria given by the AI HLEG and the ACRAI, with the important extension of including the expectations, needs and wants towards values and principles of trustworthy AI, which were established within the project's consortium. These extensions include new learnings on insights, interpretations and understandings, which, so we hope, can be used as a further step towards the development of more trustworthy AI.

Technology and ethics must act within the legal corridor. Especially criminal law plays an important role to avoid damage during the application and, thereby, prevent potential penalties against developers and companies. From a criminal law perspective, several alleged perpetrators can be considered in parallel, in our case the developer / manufacturer as individuals well as the corporation behind them should be protected by a criteria catalogue. Therefor it is particularly important to act with due diligence and predictable in order to prevent subsequent sanctions.

The concept of negligence consists of two additional elements: First, a non-due diligent behaviour (being either an action, or an omission of required action) which actually is causal for the damage, in case of our supermarket robot arm the bodily injury of another person. Second, the predictability of this damage at the time of no-due diligent behaviour. So, the first step for criminal compliant action is to define the standard of due diligent behaviour when developing the robot arm. There is a graduated system of establishing the necessary standard: First, legal ("normative") standards; second, within that normative framework or in case of absence of those rules, professional or social

code of conducts (see here the safety and security standards below); finally, in case of missing norms or defined codes of conduct, a comparison to diligent behaviour of (professional) peer groups (we speak about the acting of the "perfect person" in a comparable situation). Second, due diligence standards require sufficient risks assessment. This includes not only the assessment of existing risks in the application but also the consideration of future dangerous situations. The predictability of potential risks, in general, limits potential accusations of negligent acting. However, especially the implementation of innovative methods and systems demands for supervision of these products. Supervision enables to detect potential risks in process. Thus, supervision forms part of due diligence standards.

Examples of criterion related to the digital supermarket scenario could then be formulated as follows: (a) General criterion to objective acting with due diligence: Is the acting during the development objectively in line with due diligence standards? Are all the standards / leges artis followed? (b) Case-specific: Have all the relevant safety norms been followed in order to avoid that persons are bodily injured? Especially, have ISO 10218-2:2011 and ISO 13482:2014 been followed? (c) General Criterion to predictable risks assessment: Have all the foreseeable / predictable risks emanating from the AI system in action been assessed in the development process? (d) Case-specific: Have all the potential risks been analysed that could result in bodily injury of a person using the arm? Have any possibly dangerous situations been considered that could arise from the user / buyer of the arm?

A total exclusion of risks of liability cannot be guaranteed, but it will limit the risks of sanction and it will contribute to the development of a trustworthy AI system.

4.2 Criteria on safety and security

The assessment of a robot application for safety and security always has many application-specific aspects which are hard to generalize. However, in order to establish a criteria catalogue for an initial proof-of-concept, we have used corresponding standards as a basis for our work. In terms of robot safety, we have extracted general guidelines from the ISO-10218-2 [18] "Safety requirements for industrial robots: Part 2: Robot Systems and integration" for stationary robots and ISO-13482 [19] "Robots and robotic devices — Safety requirements for personal care robots" for mobile platforms. We have categorized the requirements and formulated questionnaire questions that can be presented for a later user. Both standards are hard to bring into a machine-readable form since they are not as much checklist formed as others and have many requirements hidden in prosa text. For this proof-of-concept, we have extracted 45 requirements and associated question blocks from ISO-10218-2 and eight such blocks for ISO-13482 (selection of blocks focusing on the safety of the end-product).

For security requirements, we referred to the IEC-62443 [20] "Industrial communication networks - IT security for networks and systems" standards series. It defines requirements and processes for multiple actors involved in developing a secure industrial system, namely the component vendor, the system integrator and the end user. We have specifically used sub-standards 3-3 and 4-2 which define the requirements for the integrator and the component vendor respectively. IEC-62443 defines multiple security

levels depending on which kind of attacks a system should be secured against (ranging from incidental manipulation to highly skilled groups with extensive resources). Based on the requirements tables and the associated explanations in the documents, we have formulated example questions for a later questionnaire presented in D5.1 [10].

5 Assistance System to Approve Models

We introduce the model-based assessment assistance system – depicted in the figure below - [11] by linking the different criteria with models that steer robots. After the assessment a digital signature is attached to the models, ensuring quality approval. The experiments faced among others, three key challenges: (1) The model can be checked with regard to legal, ethical and security & safety issues. Essential is the generation of the catalogues and the assessment of models [10]. (2) The modelling of AI and robotics and how assessment ensure compliance [11]. Approved models are signed using hash-codes to avoid fraud, as changes in the models result in a mismatch when comparing the signature. (3) The third challenge is operating compliant models on a robotic platform [9]. Before using the models on the robotic platform their validity can be ensured by means of certification checks. A technical mounting on the robot is necessary that this validation check is performed before starting the execution.

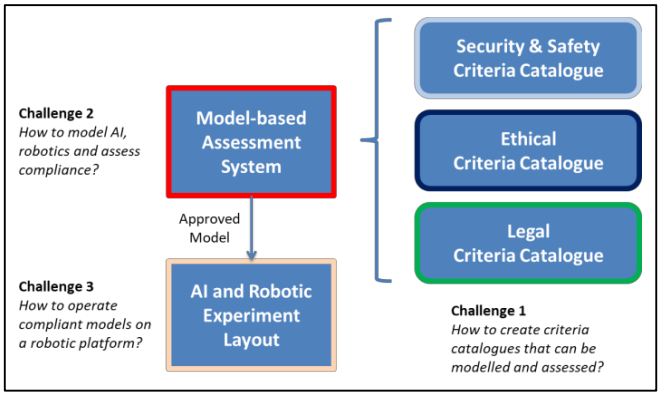

Fig. 2. Depicts the linkage of assessment criteria with the executable workflows

The assessment of a workflow is based on the idea that assessment criteria can be formulated by corresponding safety-, security-, legal- or ethical- experts. Those criteria are then transformed into a semi-structured questionnaire model. The meta model of this questionnaire defines answer types, such as single answers, multiple answers, or textual answers as well as how those answers are then used to calculate a so-called score value. This score indicates if answers to a set of questions can be considered as complaint – green values, not-complaint – red values, or yellow value that are in between and hence need further (expert) investigation. More details on how to link the questionnaire model with the workflow can be found in D4.1 [11] of complAI.

After successfully assessing the workflows, the model is digitally signed using an authentication environment and a digital signature of the model. A cryptographic environment has been designed to ensure that the whole process of developing, assessing, certifying and executing a robot program is secure. This environment has been published in [21]. The verification process is realized in form of a distributed ledger to ensure integrity, authenticity and non-repudiation of the artifacts resulting from the verification process as well as the development process itself. In this context the information shared by the peers is grouped in channels, which ensures privacy of sensitive information as the channel access can be restricted by the use of certificates.

Material for download can be found in [2, 12, 13, 14, 19].

6 Available Results

We experimented with the use case where a customer chooses fruits from a mobile app, enter the shop and a pick and place robot already prepared the basket. The challenge is to describe the (a) process of "picking and placing", and (b) decision which fruit to pick. A simple sequence was modelled – as shown below – as a Petri-Net [15].

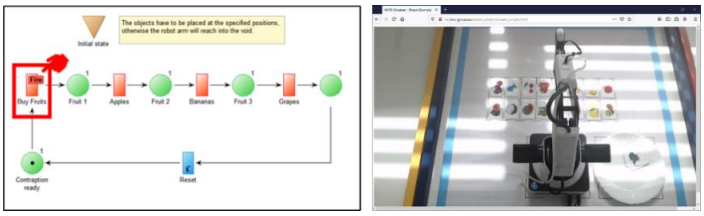

Fig. 3. Shows a Petri-Net describing a simple pick-and-place procedure for a robot arm. Each transition invokes an action from the robot that is shown as a life stream picture on the right

The target model is an adaptive pick-and-place workflow in BPMN format [16] executed by a workflow engine. The corresponding models are in the figure below. In order to transform the simple pick-and-place sequence, we used to a flowchart representation, introducing sub-processes for certain robot movements and expressing the decision pints via user interactions. This enables an explicit demonstration how decisions influence the workflow. In our case the interpretation is based on sensor information which fruits are available and to select the correct choice. This decision point is experimented with a user interaction. The flowchart representation therefore enabled a mock-up of the workflow with adaptive behaviour. The resulting BPMN workflow was implemented on a workflow engine combining the sub-workflows for movements, the orchestration of the movements and the indication of intelligent interaction.

The proof-of-concept engineering of intelligent robot interaction using workflows was based on the following default setting: (a) The pre-packaged Dobot Magician [18] was used to demonstrate the robot arm. (b) The corresponding IoT Adapter – Raspberry-Pi – and corresponding software – Tomcat Web-Application, Dobot Magician interfaces. (c) The pre-installed Modelling Toolkit Bee-Up is used for modelling the Petri-Net, the flowchart and the BPMN processes that accesses the IoT Adapter. (d) A

third-party workflow engine was used. The configurations can be downloaded from the complAI ADOxx.org developer space [19].

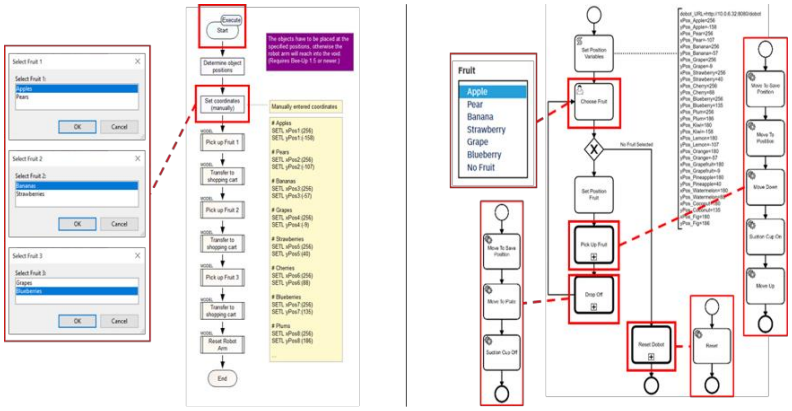

Fig. 4. Introduces a pick-and-place workflow picking up cards with fruit-symbols and introduce dynamic behaviour via sub-processes in form of a flowchart or BPMN workflows

7 Outlook and Next Steps

The paper introduces the co-creation of domain-specific assessment and certification solutions for robots using AI, based on a stakeholder interaction, literature research, experiments within the OMiLAB Innovation Corner and prototypes using a robot.

This model-based approach simplifies the configuration of robots and in addition allow to apply algorithms such as analysis, the management of releasing a model and the integration with AI-algorithms that make a workflow adaptive.

The linkage of a workflow model with so-called assessment criteria that are managed by legal advisors, security experts and ethical advisors enables an eco-system, where experts can cooperate without the need of conceptualization capabilities but by using the modelling-framework that supports the transformation from text to concept models.

When certifying a model – approving that this model passed the technical, legal, security or ethical reviews – this model is then digitally signed to ensure that only certified models are executed on the robot.

Our expectation is that these results support work on higher reliability, governance, risk management and compliance when cyber physical systems act autonomously.

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Examining Future Ready Accounting Course (FRAC) Experiences for Non-Accounting Students: An Education in Society 5.0 using Augmented Reality and IoT

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Abstract. An accounting course today has become an essential syllabus for social sciences students, particularly, in business, management, and entrepreneurship. Since social sciences students are not purely accounting students, learning accounting is proven to be more challenging for them and innovations for the course, including the methods used in teaching the accounting course. This study aims to develop a Future Ready Accounting Course (FRAC) for non-accounting students by using simple augmented reality technology, embedded into the course's teaching and learning method. This study examines the non-accounting students' experiences of applying FRAC in their accounting courses. By using a mixed method approach, questionnaire surveys were conducted to examine the students' experiences towards FRAC revolving three elements of the course, lecturers, and infrastructures or facilities. Since the lecturer teaching FRAC composed one member of the research team, a field observation also carried out to monitor the FRAC's implementation. The results of the study reveal an evidence that an accounting course can indeed be taught in more innovative and attractive ways. In other words, accounting departments would do well to consider the novel contribution made by this study by adopting FRAC to replace the old-fashioned conventional accounting courses. It is noted that the non-accounting students employed in this study were able to feel a new experience in learning an accounting course with the adoption of FRAC. This significantly concludes that FRAC can successfully attract and help non-accounting students to excel in their accounting courses to fulfil the requirements of their degrees.

Keywords: Education for Society 5.0, Future Ready Accounting Curriculum, Augmented Reality, Internet of Things.

1 Introduction

An accounting course is undeniably no longer limited to only accounting students [3]. This is chiefly because accounting is not a narrow discipline. In other words, the accounting discipline encompasses knowledge beyond the traditional understanding of bookkeeping, debits, and credits. In fact, the accounting field covers wide areas of

knowledge that non-accounting students must be equipped with, such as corporate governance [4], earning management [5], risk management [6], and [7] etc. All of these knowledge is ultimately useful for graduates when entering and competing in the employment market. Students equipped with accounting knowledge and skills will find it easier to be employed in comparison to those without. [3][8]. In essence, an accounting course today has become a compulsory or a pre-requisite course for non-accounting students before they are allowed to take advanced courses, depending on their undergraduate programme's specialties or majors. These non-accounting students mostly come from the business, management, and entrepreneurship programmes [9]. These students must therefore grasp the basic functions of accounting knowledge and skills, valuable in helping them manage the financial and non-financial aspects of a business. However, it is noted that some of them have found it difficult to learn accounting [9]. There are many explanations for that, with one outstanding explanation being that the traditional accounting course is 'old fashioned', less attractive, and less engaging for students. Besides, the advent of the Industrial Revolution (IR) 4.0 suggests that technology is ultimately an indispensable tool in optimising outputs, in this case, increasing the innovations and attractiveness of a conventional accounting course. In other words, it is necessary for accounting courses to be embedded with the latest innovations and technologies in order to cover existing loopholes and make the courses more attractive for non-accounting students [9] [11], in particular, those from the Society 5. 0. Integration of technology in the teaching and learning method for the course is ultimately necessary as it can encourage students to provide better interest and participation towards the course.

Although the demand for a future-ready curriculum is growing [12] [11], the action taken on improvising and developing the course is proven to be too sluggish. Many studies have been conducted to show the need to develop a future-ready course for students. (see [11] [8]) Unfortunately, among those, very few studies have tried to propose relevant processes and methods to develop a future-ready course. The study hence aims to develop a future-ready curriculum, in particular, focusing on an accounting course for non-accounting students.

Evidently, students in the pure sciences disciplines are naturally more technologically-savvy than those in the social sciences disciplines. This is due to the simple fact that technology is a prominent feature in the disciplines of the former. For example, the use of machines to analyse scientific samples and report results of experiments, or the use of artificial intelligence to conduct specific laboratory chores, providing additional mileage to human limitations, all help enhance the familiarity of technology to pure sciences students. For most pure sciences students, laboratories are regarded as their playgrounds, offering a particular excitement and experience in the teaching and learning processes of the pure sciences courses. That subjective value ultimately creates voluntary participation among the students in learning the courses. On the other hand, social sciences students are still largely entrenched in in the traditional ways of teaching and learning the courses. Their exposure to technology are in fact found greater outside of the teaching and learning activities of their courses than inside them. This situation therefore influences the students' commitments, interests and participations in expecting more innovative and attractive social sciences courses. In essence, students from

both pure sciences and social sciences must be equipped with technology-based courses to increase their engagement and excitement in their learning experiences [13]. Acknowledging this loophole, this study therefore firmly believes in the need for technology to be embedded into existing social science courses, in particular, the accounting course.

2 Problem Statement

A conventional accounting curriculum currently lacks in its efforts to embed latest technological trends into its syllabus. On top of that, the curriculum also simultaneously fails to equip students with additional set of skills, necessary for students to enhance their employment marketability in the near future. Indeed, it is unfortunate that many students today graduate without being equipped with future-proof skills and sufficient exposures of current trends. This naturally leads to many graduates facing additional challenges in getting a job placement as many employers naturally prefer graduates with better technological and digital knowledge and skills. Hence, this explains the need for students to be supplied with a future-ready curriculum incorporating a greater number of contemporary skills (i.e. digital skills, communication skills, interpersonal skills, etc.) in their learning experiences.

Besides, the year 2020 witnessed an aggressive shift towards digital-based teaching and learning activities. The coronavirus pandemic has impacted every aspect of human life [14], including the education sector. A massive amount of courses around the world are transforming their modes of delivery from that of a non-face to that of a face-to face. In this context, the pandemic has forced the society to follow standard operating procedures to reduce the virus from spreading, for example, through the implementation of social distancing in public places. [15]. However, in reality, social distancing has a unique side effect to the traditional activities of teaching and learning. For instance, lectures and tutorials now have to be conducted online through synchronous or asynchronous methods. In the context of accounting courses, this pandemic situation alone proves that the current curriculum is no longer relevant to be practiced and need to be improved or transformed into a future-ready accounting curriculum. In retrospect, the pandemic and the consequential new norms have become the push factors for transforming the conventional accounting curriculum towards one that is forward looking and indeed, future-ready [16].

3 Methodology and Design

Fig. 1 shows Simeon (1999, 2001) the Attracting, Informing, Positioning and Delivering (AIPD) framework that has been adapted and modified according to the context of this study. The framework shows that there are four elements regarded as independent variables for the previous study, namely, attracting, informing, positioning, and delivering. The four elements are also called strategic dimensions within the framework. These elements affect the way an ‘object’ becomes more attractive, dynamic, innovative, trustworthy, and exciting. Based on the current study context, the ‘object’ here

refers to the accounting course. Furthermore, Fig. 1 also implies that an attractive, dynamic, innovative, trustworthy, and exciting accounting course would naturally create positive feedbacks (i.e. positive perception towards the course) from the students.

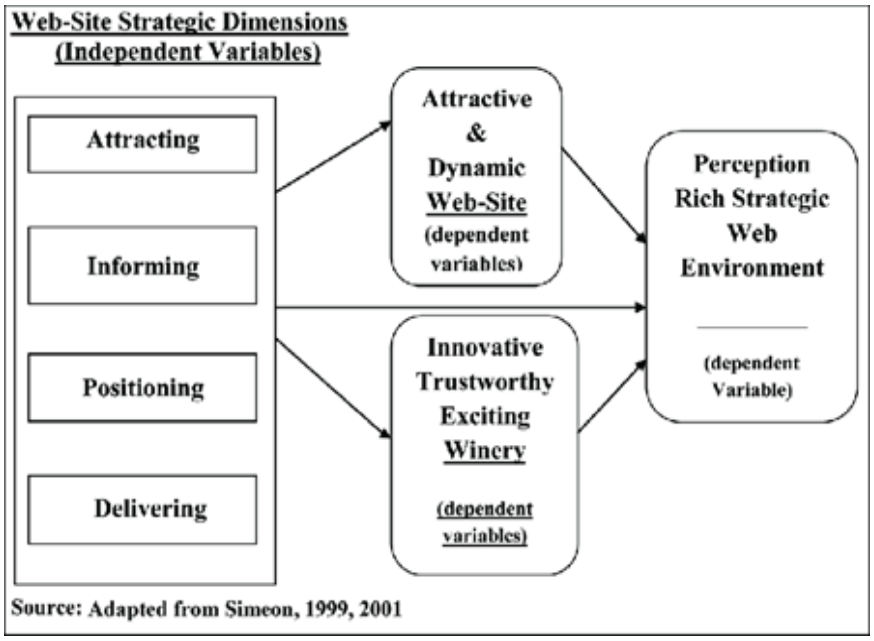


Fig. 1. AIPD framework

3.1 Design of FRAC

In this research, the project design flow in Fig. 2 proposes seven phases of developing and implementing FRAC for students. This design is primarily based on Simeon (1999, 2001) AIPD framework.

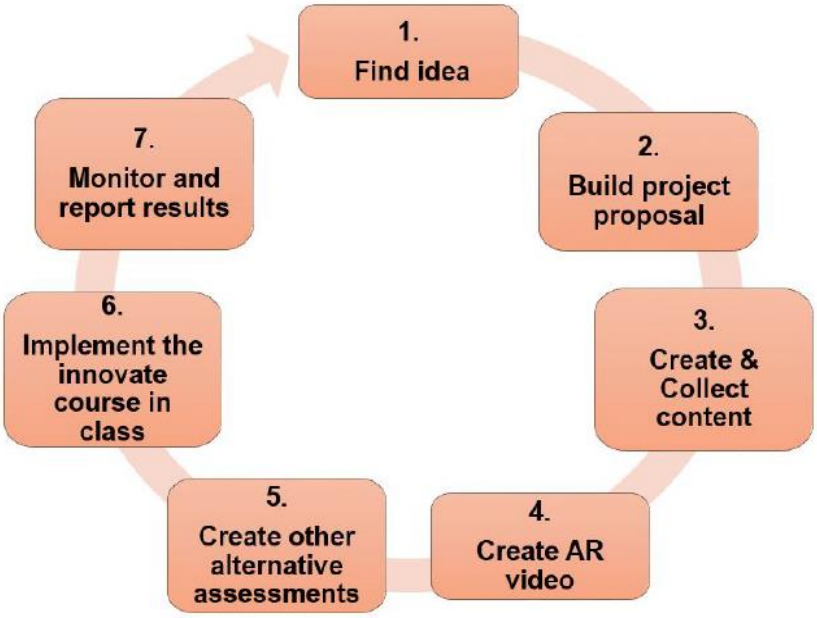


Fig. 1. Project design flow

Phase 1. In the first phase, the project began with a series of discussions on finding a suitable idea (i.e. innovative and attractive accounting course) for the project. In addition, the discussions were complemented with in-depth readings on the subject matter - the accounting course. The outcome of the discussions and in-depth readings led the research team to an idea that seeks to innovate and restructure existing conventional teaching and learning activities, particularly, for the accounting course. The course needs to be reformed in order to suit current demands arising from rapid technological development, students' preferences, as well as universities' and industries' needs. The idea also reflected the government's aspiration to encourage educational institutions, such as higher learning institutions to produce future-ready curriculums for students in preparing them to meet the contemporary demands of industries. Upon confirmation of the idea with the research team, the project was named Future Ready Accounting Curriculum (FRAC) for non-accounting students.

Phase 2. In the second phase, more discussions on the agreed idea were performed. The discussions were now focussed on sharing all ideas to build the project's proposal. The project was a strategic collaboration of a research team consisting of lecturers with various knowledge and expertise. The lecturers represent the multiple sub-disciplines of accounting, such as financial accounting, management accounting, financial management, entrepreneurial finance, information technology, business management, social accounting, as well as corporate governance. With a good number of experts working

together, the project proposal was prepared and completed within a short period of time. Furthermore, at this stage, the researchers have also started using technology in conducting discussions, segregating tasks and duties to each member in various geographical areas, setting working schedules, and gathering all works in order to form a complete project proposal.

Phase 3. In the third phase, the project proposal was expanded upon completion from the previous phase. Also decided in Phase 3 was the technology employed for the project's innovation. For the purpose of this project, the simple Augmented Reality (AR) technology was used to create an interactive, virtual, and integrated platform containing FRAC contents for both lecturers and students. The AR platform required various contents for FRAC, such as students' assessments, quizzes, tests, assignments, projects, and presentations to be included in one interactive, virtual, and integrated platform. Driven by that purpose, the research team also had to gather all contents during this phase. The contents were derived from existing practices which were subsequently transformed into a digital form to enable them to be integrated into the AR platform. In addition, the research team also created a few innovative assessments for non-accounting students using the platform. For instance, the students are required to create a website using a free website provider, such as Wix.com to present their projects based on their own creativity and preferences. Apart from that, the research team has also created a virtual presentation task in the platform for students in order to help assess their communication skills. The task requires the students to create a 4-8 minutes long video as a pitch for their project, which is expected to be subsequently published on YouTube, with an award promised for the most liked video.

Phase 4. In the fourth phase, the AR platform began to be assembled based on contents gathered in the previous phase. To create the AR platform, the research team used the ZapWorks designer platform as depicted in Fig. 3. The AR platform was used as a base and as an interface for lecturers and students to share FRAC contents used in conducting teaching and learning activities in both online and offline classes.

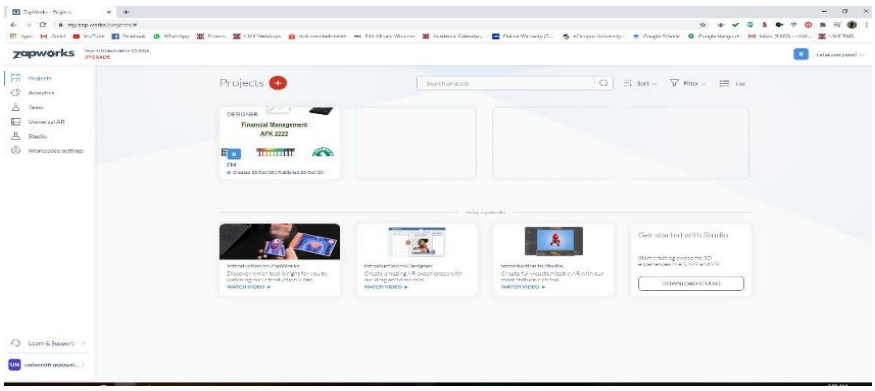


Fig. 2. ZapWorks designer platform

Fig. 3 shows the ZapWorks designer platform that was used to create the Zappar Triggers, a components used to incorporate teaching and learning materials into the platform. Once a project from the platform was published, a single user interface appeared and the platform was now ready for use for both students and lecturers. In order to arrive to the interface, students and lecturers needed to scan the Zappar Triggers using the Zappar scanner (Fig. 4) which could be downloaded for free from the Google Play store.

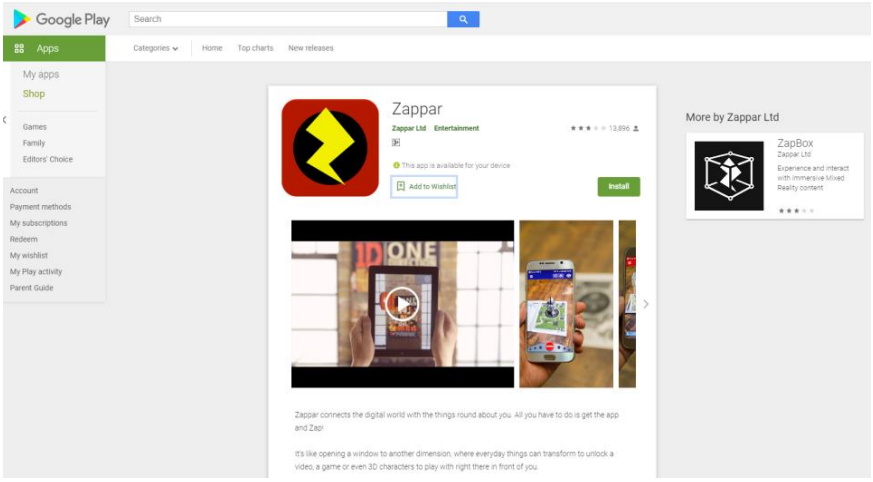


Fig. 3. Zappar scanner

Figure 5 shows the Zappar Triggers needed to be created on the ZapWorks designer platform provided to students and lecturers to enable them to scan the tracker, and enter the platform's classrooms. The trackers also provided access to materials, guidelines, instructions, assessments including quizzes, tests, project reports, videos, lecturer profiles and other materials related to the course, which have been prepared in the ZapWorks Designer Platform beforehand.

Fig. 4. Zappar triggers

The Zappar Triggers must be shared with students by lecturers or FRAC coordinators. They can be shared via the common e-learning platforms provided by the individual university or through social networking platforms such as the class' WhatsApp or Telegram groups. For the purpose of providing better information, the Zappar Triggers could be shared on a piece of poster containing brief information about the course (i.e. FRAC) or they could be also printed on a poster as depicted in Fig. 6 below.

Fig. 5. Course poster

Phase 5. In the fifth phase, other alternative assessments were created for the purpose of blended learning. The assessments were required to be suitable and relevant to FRAC. These included online quizzes, tests, exercises, accounting project reports completed and published on a website (Fig. 7), and presentation videos that are professionally edited, published, and attached on the same website.

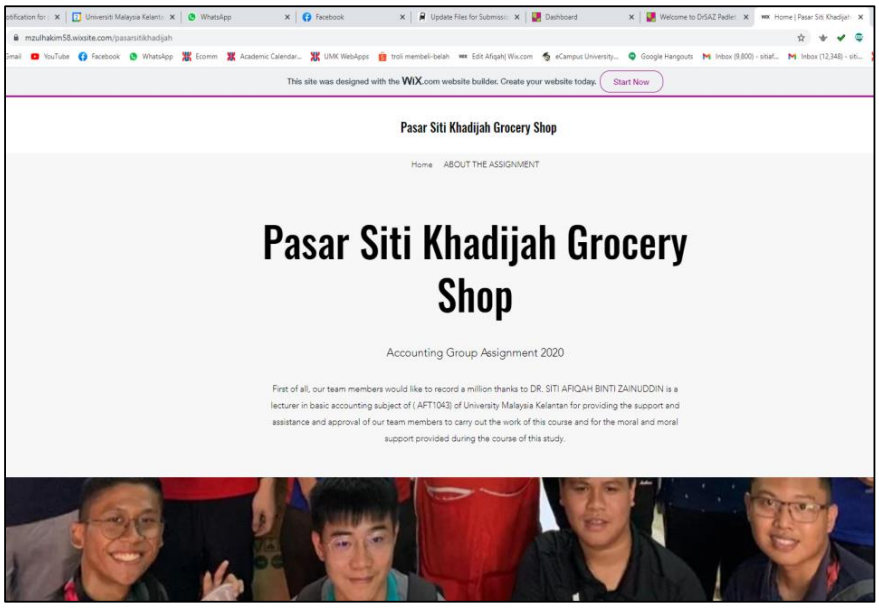
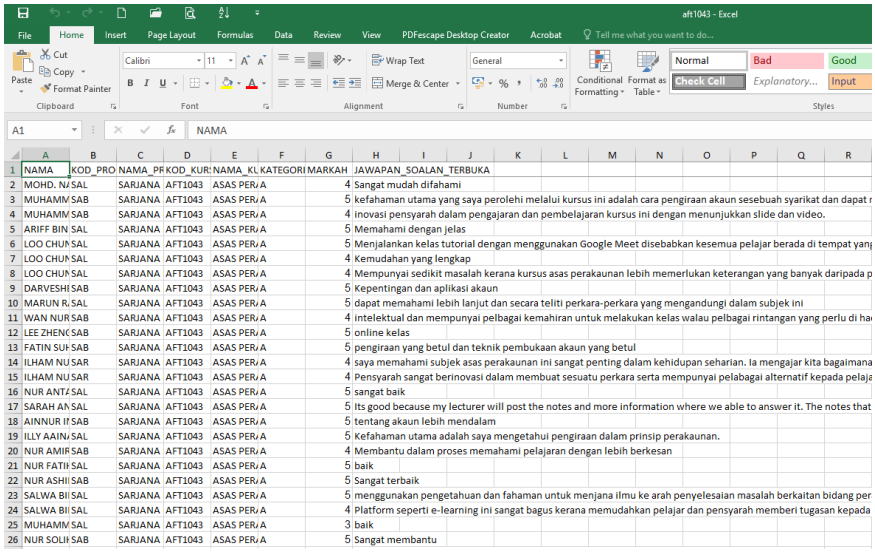


Fig. 6. Student project website

Phase 6. The sixth phase saw the implementation of FRAC in accounting classes. Students who were learning via FRAC were expected to experience more interactive and fun learning activities.

Phase 7. In the final phase, the students' responses, feedbacks and recommendations were subsequently gathered and examined. Fig. 8 shows the students' responses from the distributed questionnaire surveys. The descriptive analysis and results of the surveys are illustrated comprehensively in Fig. 9.



	A	B	C	D	E	F	G	H
1	NAMA	KOD_PRO	NAMA_PR	KOD_KUR	NAMA_KU	KATEGORI	MARKAH	JAWAPAN_SOALAN_TERBUKA
2	MOHD. NA	SAL	SARJANA	AFT1043	ASAS PER	A	4	Sangat mudah difahami
3	MUHAMM	SAB	SARJANA	AFT1043	ASAS PER	A	5	kefahaman utama yang saya perolehi melalui kursus ini adalah cara pengiraan akaun sesebuah syarikat dan dapat r
4	MUHAMM	SAB	SARJANA	AFT1043	ASAS PER	A	4	inovasi pensyarah dalam pengajaran dan pembelajaran kursus ini dengan menunjukkan slide dan video.
5	ARIFF BIN	SAL	SARJANA	AFT1043	ASAS PER	A	5	Memahami dengan jelas
6	LOO CHUN	SAL	SARJANA	AFT1043	ASAS PER	A	5	Menjalankan kelas tutorial dengan menggunakan Google Meet disebabkan kesemua pelajar berada di tempat yang
7	LOO CHUN	SAL	SARJANA	AFT1043	ASAS PER	A	4	Kemudahan yang lengkap
8	LOO CHUN	SAL	SARJANA	AFT1043	ASAS PER	A	4	Mempunyai sedikit masalah kerana kursus asas perakaunan lebih memerlukan keterangan yang banyak daripada p
9	DARVESH	SAB	SARJANA	AFT1043	ASAS PER	A	5	Kepentingan dan aplikasi akaun
10	MARUN R	SAL	SARJANA	AFT1043	ASAS PER	A	5	dapat memahami lebih lanjut dan secara teliti perkara-perkara yang mengandungi dalam subjek ini
11	WAN NUR	SAB	SARJANA	AFT1043	ASAS PER	A	4	intelektual dan mempunyai pelbagai kemahiran untuk melakukan kelas walau pelbagai rintangan yang perlu di ha
12	LEE ZHEN	SAB	SARJANA	AFT1043	ASAS PER	A	5	online kelas
13	FATIN SUH	SAB	SARJANA	AFT1043	ASAS PER	A	5	pengiraan yang betul dan teknik pembukaan akaun yang betul
14	ILHAM NU	SAR	SARJANA	AFT1043	ASAS PER	A	4	saya memahami subjek asas perakaunan ini sangat penting dalam kehidupan seharian. Ia mengajar kita bagaimana
15	ILHAM NU	SAR	SARJANA	AFT1043	ASAS PER	A	4	Pensyarah sangat berinovasi dalam membuat sesuatu perkara serta mempunyai pelabagai alternatif kepada pelaja
16	NUR ANT	SAL	SARJANA	AFT1043	ASAS PER	A	5	sangat baik
17	SARAH AN	SAL	SARJANA	AFT1043	ASAS PER	A	5	Its good because my lecturer will post the notes and more information where we able to answer it. The notes that
18	AINNUR H	SAB	SARJANA	AFT1043	ASAS PER	A	5	tentang akaun lebih mendalam
19	ILLY AAIN	SAL	SARJANA	AFT1043	ASAS PER	A	5	Kefahaman utama adalah saya mengetahui pengiraan dalam prinsip perakaunan.
20	NUR AMIR	SAB	SARJANA	AFT1043	ASAS PER	A	4	Membantu dalam proses memahami pelajaran dengan lebih berkesan
21	NUR FATI	SAL	SARJANA	AFT1043	ASAS PER	A	5	baik
22	NUR ASHI	SAB	SARJANA	AFT1043	ASAS PER	A	5	Sangat terbaik
23	SALWA BI	SAL	SARJANA	AFT1043	ASAS PER	A	5	menggunakan pengetahuan dan fahaman untuk menjana ilmu ke arah penyelesaian masalah berkaitan bidang per
24	SALWA BI	SAL	SARJANA	AFT1043	ASAS PER	A	4	Platform seperti e-learning ini sangat bagus kerana memudahkan pelajar dan pensyarah memberi tugasan kepada
25	MUHAMM	SAL	SARJANA	AFT1043	ASAS PER	A	3	baik
26	NUR SOLI	SAB	SARJANA	AFT1043	ASAS PER	A	5	Sangat membantu

Fig. 7. Students' responses, feedbacks and recommendations (in Malay language)

4 ANALYSES, Results and Discussions

Observations performed during classes and after the course was completed show how FRAC has successfully transformed traditional accounting teaching and learning activities into one interactive course for students. Students were reported as becoming more motivated and committed towards the course's requirements. Furthermore, they also became more guided, compliant and skillful when assigned more technical activities using technology and applications. These results are certainly in line with the FRAC Course Learning Outcome (CLO), intended to equip students with digital, interpersonal, communication, and entrepreneurial skills.

Meanwhile, Table 1, 2, and 3 illustrate responses gathered from 411 non-accounting students after they experienced FRAC throughout one semester. Item Number 2 and 5 in Table 1 show the highest mean score which were 4.5 each. The score indicates that information about the scope of the course's contents were not only accurate, but were also clearly distributed and explained to the students in beginning of the course. The scope of the course' contents is also the most crucial part which guides and tells the students their directions throughout the course, as well as the level of preparation they are required to have before commencing the course.

Table 1. Students' evaluation on course of FRAC

A. Course		Mean score 4.4
1	This course increases my interest to study the related field much deeper.	4.4
2	This course has a proper scope of content.	4.5
3	This course contains important skills, concepts and information.	4.4
4	This course helps my intellectual development.	4.4
5	There is a course briefing in the early semester	4.5
6	Teaching activities help the inculcation of soft skills	4.3
7	Assessment results are informed to students in a reasonable time	4.4
8	Generally, I am satisfied with this course	4.4

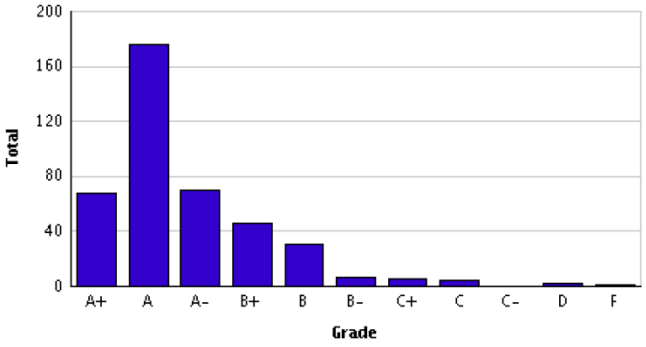
Table 3 shows students' responses on the infrastructures and facilities during FRAC's implementation. The overall mean scores show that most students gave a 4.1 out of 5.0 rating for this key element of the course. Item Number 6 has the highest mean score with 4.2, referring to the students' satisfaction with the teaching and learning facilities provided in the course.

Table 2. Students' evaluation on infrastructure and facilities of FRAC.

C. Infrastructures /Facilities		Mean score 4.1
1	Class environment and physical facilities provided support the teaching & learning activities of this course.	4.1
2	ICT facilities (internet, laboratories, and software) provided support the teaching & learning activities for this course.	4.1
3	Space provided supports individual and group learning for this course.	4.1
4	Resources available for this course in the library are adequate.	4.1
5	Teaching aids (microphone, LCD, screen, etc.) provided are satisfactory.	4.1
6	In general, I am satisfied with the teaching and learning facilities provided for this course.	4.2

Figure 9 shows the students' course grade analysis for FRAC. It was found that 314 out of 411 non-accounting students scored A+ to A-, or approximately 76.40 percent of the total number of students, in their experiences with FRAC. Meanwhile, the average mark obtained among the students was 80 out of 100 with a standard deviation of 10. Based on the observations and lecturers' reports, the one student who obtained a fail for the

subject, did not in fact participate in FRAC since the beginning and has made an intention to drop, thus never having had a full experience of FRAC.



A+	68
A	176
A-	70
B+	46
B	31
B-	7
C+	6
C	4
C-	0
D	2
F	1

Fig. 8. Students course grade analysis.

This finding is parallel to findings of other studies that conclude embedding technologies in the teaching and learning activities leads to an upward shift in the students' performance [17] [18].

5 Conclusions, Limitations and Recommendations

In summary, FRAC is a suitable and desirable course for the Generation Alpha students (also known as the Society 5.0 students) who are easily captivated by a comprehensive integration of technology in various aspects of life, most particularly, in education. Indeed, this study has produced a novel output for students, lecturers, as well as education providers in the area of accounting. The novel invention not only improved and built on the traditional accounting teaching and learning activities, but also encouraged the level of students' commitment, participation and understanding towards the course. However, in addressing limitations for the study, there are definitely plenty other promising new technologies out there that can be used to provide innovations for the course, such as the Internet of Things (IoT) and Big Data, worth to be explored in future researches. Furthermore, this study can also be replicated for other academic courses and not only limited to accounting courses. As regards to recommendations, this study has proposed a few for students, lecturers, education providers and the Ministry of Education alike. With regards to students, FRAC is an indispensable tool to enhance the students' interests and motivation in learning an accounting course as it provides an interactive learning experience, especially to the Generation Alpha (Gen Alpha) students

who are typically technology savvy. Meanwhile, with respect to lecturers, FRAC will be found to be a sophisticated teaching method in teaching an accounting course, especially, to the Gen Alpha students. FRAC is promised to be the most efficient and effective teaching and learning alternative to expose the Gen Alpha students with a sufficient set of contemporary accounting skills alongside the disciplinary knowledge in finance. On the other hand, education providers will find FRAC a stellar example to other courses and schools. As for the Ministry of Education, they will find FRAC perhaps, as one example of best practice or guidelines to be recommended to most educational institutions in building an innovative curriculum and transforming existing traditional curriculums. This initiative is also undoubtedly parallel to the practice recommended by the Ministry to promote innovations in the existing universities' curriculums to suit the current landscape and fulfil demands of the industries. On top of that, FRAC is also aligned with the Ministry's current aspiration to enhance the existing educational system to adapt competitively to a plethora of demands and challenges arising from the IR 4.0.

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Part II

Society 5.0 Proceedings
Volume II

Building a Taxonomony of Industry 4.0 Needs and Enabling Technologies.

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Abstract. A thorough understanding of the concept of Industry 4.0 is needed to assess the overall plethora of I4.0 enabling technologies and define their application domains and uses. The objective of the research paper is to review Industry 4.0's main application fields and examine which enabling technologies are used in use cases in the industrial environment, as well as developing two taxonomies: one for enabling technologies in the Industry 4.0 world and the other for classifying I4.0 problems. This taxonomy can be used for both product innovation and product optimization in industrial companies' strategic planning. This goal was met by analyzing the state-of-the-art in Industry 4.0 based on recent scientific developments and real-world use cases in industrial enterprises.

Keywords: Industry 4.0 applications · Edge Computing · Artificial Intelligence · Machine Learning · Internet of Things.

1 Introduction

The fourth Industrial Revolution, also known as I4.0, is now in full swing. The word "Industry 4.0" was coined in Germany when the government and private sector, led by Bosch, formed a research group to make German manufacturing more competitive in the global market [1]. This term encompasses all manufacturing domains and includes advanced manufacturing technologies that collect, optimize, and deploy data.The idea of German government behind Industry 4.0 is to exploit the potentials of new technologies and concepts such as :

- availability and use of the internet and IoT
- integration of technical processes and business processes in the companies
- digital mapping and virtualization of the real world
- 'Smart' factory including 'smart' means of industrial production and 'smart' products

Smart factories are equipped with sensors, embedded software, and robotics solutions that collect and analyze data for better decision-making. Analysis of large amounts of data can provide tools that perform predictive maintenance, self-optimization of the process, and meet customers needs more cost-effectively which was not possible before.

Industry 4.0 technologies assist businesses in managing production planning and scheduling, capacity usage, maintenance, and energy conservation, as well as allowing for customized solutions, flexibility, and cost savings in manufacturing processes.

A question that many experts ask nowadays is **what are the typical problems that can be addressed by Industry 4.0?** Industry 4.0 allows comprehensive real-time tracking of operations, allowing for real-time data collection, monitoring, and maintenance; it implements a new and significantly enhanced system of development, service provision, mode of supply, storage, distribution and a significant enhancement of business support activities. One of the challenges faced by Industry 4.0 is managing the large amounts of data produced by analyzing output data and integrating the results with customer information systems.

Big data analysis may help managers detect defects, faults, and flaws in the manufacturing process at an early stage, optimize automation processes and conduct trend studies, use resources more effectively, and perform predictive maintenance. Predictive maintenance identifies equipment failure before it happens, allowing you to continually improve the production process and increase manufacturing performance.

Given this wide range of potential enhancements enabled by 4.0 applications another question arises: **What are the 4.0 key enabling technologies?**

In the Industry 4.0 environment, the European Commission identifies nine main enabling technology developments (Figure 1.) and investigates their possible technological and economic benefits for manufacturers and production equipment suppliers [2]. We used the enabling technologies provided from European Commission as guidelines for our research, for categorize the technologies.

These enabling technologies are Advanced Manufacturing Solutions , Additive Manufacturing, Augmented Reality, Simulation, Horizontal/Vertical Integration, Industrial Internet, Cloud, Cyber-security, Big Data, and Analytics; their existence helps in turning manufacturing into a completely digitized and intelligent operation.

Furthermore, according to the Microsoft study [3], crucial technology drivers for IoT success in the coming years are AI, Edge Computing, and 5G. Companies should be aware of these enabling technologies' capabilities and they need a detailed technology roadmap and guide lines for incorporating enabling technologies into their strategies and businesses. There are still many companies that doesn't know the potentiality, benefits and how of use Industry 4.0 and AI technologies for improving the productivity and quality of the company.

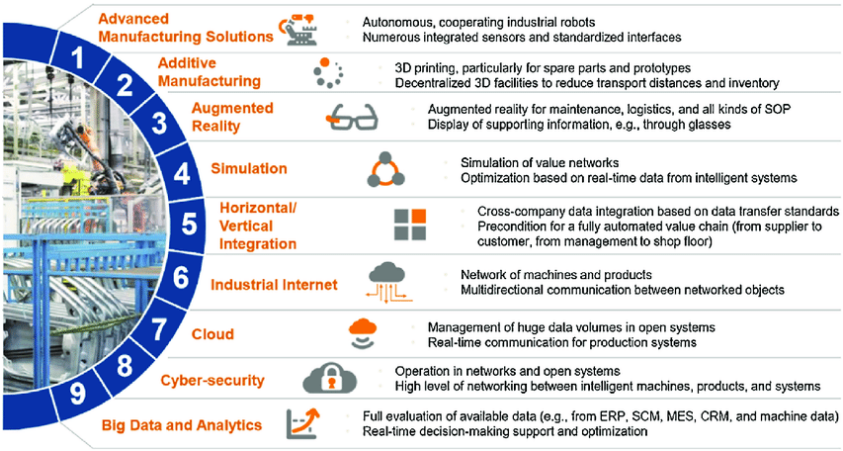

Fig. 1. Key nine enabling technology trends.

AI technologies are methods and procedures that allow technical systems to interpret their environments, solve problems independently, find new ways to solve challenges, make decisions, and, most importantly, learn from experience to become more proficient at completing tasks and actions, according to the industry.

The AIoT paradigm [4] , the combination of AI with IoT has become popular during recent years. It's a groundbreaking computing approach that can contribute to the creation of more scalable, effective, and secure I4.0 solutions.

For help the companies to use enabling technologies and improve the productivity and quality , we tried to answer the following questions : **1) Which of these Industry 4.0 addressable issues and which of these Industry 4.0 key enabling technologies have been implemented and used in industrial use cases? 2) Is it possible to create a taxonomy that categorizes I4.0 problems and supporting technologies? 3) What is the relationship between I4.0 issues and enabling technologies?**

2 4.0 Taxonomies Building

There is a need to look beyond scientific articles to find answers to these questions. As a result, we conducted desk research using academic papers as well as white papers, business use cases, and consulting company reports as sources. Two taxonomies were developed, one based on enabling technologies in the Industry 4.0 environment, and the other for classify I4.0 problems. The two taxonomies are connected by the use cases founded on white and academic paper. Each use case was regarded as representative of one or more Industry 4.0 issues, from which we extracted the I4.0 enabling technologies that were used to solve the issues.

2.1 4.0 innovation problems

First of all, we can divide the I4.0 innovation problems into 2 main categories: Product innovation, Process optimization .

- **Product Innovation** - aims at building a new generation of products that are typically IoT connected thus migrating the business toward a service-based solution. Product Innovation in the 4.0 era also aims at improving the usability of products by making them easier to use and understand.
- **Process Optimization** - aims at improving the efficiency of production processes to reduce the product and goods production costs. Industrial processes can be optimized by improving the efficiency of equipment, workforce and supply-chain. It consists of changes of production processes of the product/service, and may not necessarily have explicit impact on the final output, while increasing the productivity and reducing producing costs .

From Product Innovation we can derive other sub-problems of I4.0 as:

- **Product Servitization** the innovation of organization's capabilities and processes to better create mutual value through a shift from selling product to selling Product-Service Systems
- **Usability Improvement** product usability improvement by designing user interface, with usability testing, targeting customer.
- **After-Sales support** any service provided after a customer has purchased a product
- **Automatic consumables reorder** measuring consumable usage to reliably determine when to increase or decrease the production
- **Inventory Management** is a systematic approach to sourcing, storing, and selling inventory, both raw materials (components) and finished goods (products).
- **Cost and Number of parts Reduction** is the achievement of real and permanent reduction in unit cost of products manufactured
- **Smart products (self-diagnosing products)**

From Process Optimization we can derive more sub-problems of innovation on I4.0 as :

- **Equipment efficiency improvement**
  - **Real-time Production monitoring and Supervision** : Constant stream of data about the overall health and performance of assets and production lines. Real-time alerts can help operators quickly address any issues before they become major failures that can cost plant valuable time and money. With the right information at their fingertips,operators can make faster, more data-driven decisions to ensure your optimal performance
  - **Predictive maintenance** : Detects the early signs of equipment malfunctions, allowing store managers to prepare spare machinery and avoid downtime. The IoT enables reducing downtimes and machine repair expenses, facilitating warehouse management considerably

  - **Smart Scheduling** : The adoption of Smart Scheduling will allow industries to profit from the cumulative experience in their fields (for instance, facilitating the selection of appropriate rescheduling strategies). In turn, the adoption of tolerance scheduling allows making intuitive and natural decisions, seen from the point of view of the requirements of manufacturing industries, overcoming the resistance to the implementation of Smart Manufacturing and Industry 4.0 environments, usual among personnel in traditional firms
  - **Vertical interconnection and integration (between departments in a factory)** The integration of IT systems at various hierarchical production and manufacturing levels, rather than horizontal levels, into one comprehensive solution
- **Worker security improvement and accident prevention**
  - **Smart PPE (personal protection equipment)** PPE, such as safety shoes, ear plugs and protective eyewear, has always been important in protecting the wearer from one or many occupational safety and health (OSH) risks. If an activity carried out by a person — the wearer of the PPE — involves a certain risk that cannot be further reduced by other (collective technical or organizational) means, the use of PPE is essential to enable that person to do their job without or with less risk of injury. PPE must function reliably and provide a high level of protection. This principle of the hierarchy of prevention has been successfully used for a long time.
  - **Worker attention and mental state monitoring** Improving working conditions based on real-time temperature, humidity and other data in the plant or warehouse, quick detection and enhanced protection in case of incidents, detection of presence of gasses, radiation and so forth, better communication and collaboration possibilities, a focus on ergonomics,clean air and clean factory initiatives (certainly in Industry 4.0 as the EU wants to be leading in clean air and clean anything technologies)
- **Worker routine and operation optimization**
  - **Time and Method smart measurement** Scheduling is the process of arranging and controlling workloads via shift work scheduling and data analytic.
- **Supply Chain**
  - **Horizontal interconnection and integration (between different actors of the supply chain)** Horizontal integration in Industry 4.0: from supplier to consumer, end-to-end integration of IT systems and information flows with IoT, analytics and data
  - **Production on demand enabling technology**
  - **Smart warehouse** IoT solutions for warehouse management provide real-time data on product locations, transportation conditions, the integrity of packaging, and so on. Thanks to instant updates, store managers can ensure no inventory is lost during transportation and ensure that supply chain vendors are managing deliveries responsibly

- **Supply chain transparency and reliability improvement** Achieving supply chain transparency is the fundamental process of increasing visibility, traceability and transparency by collecting and sharing information throughout the supply chain and communicating it to authorised internal and external stakeholders. The purpose of improving the reliability of supply chains is to meet the needs of consumers as quickly and qualitatively as possible

2.2 4.0 needs and enabling technology identification

Table 1 shows a list of sources that can be used to build a taxonomy of both problems and enabling technologies. The white paper, research paper, and business use cases were all considered sources for the development of two taxonomies, as shown in the table.

Table 1: List of articles for development of a Taxonomy.

Article Name	Article Type	Publication Date
AI in production [5]	white paper	7 Mar. 2019
Optimization of machining process [6]	academic paper	2 Mar. 2019
AI for defect detection [7]	business use case	30 Mar. 2020
Predicting Defects in Manufacturing [8]	academic paper	Oct. 1999
IoT Impacts the Supply Chain [9]	white paper	22 Oct. 2019
Smart Scheduling [10]	academic paper	Aug. 2018
Process Discovery: Capturing the Invisible [11]	academic paper	Mar. 2010
Designing a novel shuttle with picking system [12]	academic paper	2019
Condition monitoring in I4.0 [13]	academic paper	2019
Industry 4.0 in the tobacco industry [14]	academic paper	Feb. 2020
Logistic Industry Innovations with IoT [15]	white paper	17 Sept. 2019
ML in Demand Forecasting [16]	business use case	20 June 2020
Edge - Computing [17]	business use case	25 Aug. 2020
Predictive Maintenance using ML [18]	business use case	
5G Heart of Industry 4.0 [19]	white paper	
Real-Time Production Performance Monitoring [20]	business use case	
Smart Warehouse System [21]	business use case	
Blockchain-enabled IoT shipment tracking system [22]	business use case	

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Article Name	Article Type	Publication Date
Vehicle Tracking and Fleet Management [23]	business use case	
Smart Tracking Solution [24]	white paper	
Reducing Complexity with Simplicity [25]	academic paper	August 2015
IoT Order Fulfillment [26]	white paper	
Asset Tracking [27]	business use case	
Predictive Maintenance [28]	business use case	
Predictive Analytics Using Rattle and Qlik Sense [29]	business use case	
Supply Chain Management [30]	white paper	
IoT in Retail [31]	business use case	
Remote Measurements Control[32]	busines use case	
IT plus OT convergency for your automation solution [33]	white paper	
Data driven technology for efficiency in energy intensive industries [34]	white paper	
Improving stores efficieny using clients shopping times [35]	white paper	
Smart PPE and IoT to improve workplace safety [36]	white paper	
Cost Management For After-Sales Supply Chain [37]	white paper	
IoT Retail with Consumer Smartphone detection [38]	business use case	
IoT Industry Solution [39]	white paper	
Tracking System [40]	white paper	
Product Service System for aerospace maintenance [41]	academic paper	May 2012
Artificial intelligence at the edge [42]	white paper	
Energy sources optimization [43]	white paper	
Predictive maintenance and production optimization[44]	white paper	
Leveraging IoT Framework [45]	academic paper	Sep. 2020

2.3 4.0 enabling technologies

The focus of the research was done on Advanced Manufacturing Solutions, Horizontal/Vertical Integration, Industrial Internet, Cloud, Big data and Analytics out of key nine enabling technology trends from the European Commission, that was mentioned in the Introduction section since based on the found sources these

five enabling technologies are said to play a crucial role in the solution of Industry 4.0 problems. Table 2 lists all the technologies investigated in the literature which are considered as enabling technologies of Industry 4.0. The taxonomy was derived using as main categories the same categories identified by the European Commission. Many of the key nine enabling technologies that form the basis for Industry 4.0 are already in use in manufacturing, but when combined with Industry 4.0, they will transform production: isolated, optimized cells will come together as a fully integrated, automated, and optimized production flow, leading to a shift in traditional production relationships among suppliers, manufacturers, and customers—as well as between human and machine. The following is a list of enabling technologies that were considered when creating a taxonomy of enabling technologies [46]:

- **Big Data and Analytics** - the collection and comprehensive evaluation of data from various sources production equipment and systems will become standard to support real-time decision making.
- **Industrial Internet** - devices will be enriched with embedded computing and connected using standard technologies.
- **Cloud** - machine data and functionality will increasingly be deployed to the cloud, enabling more data-driven services for production systems.
- **Horizontal/Vertical Integration** - functions from the enterprise to the shop floor level are not fully integrated. With Industry 4.0, companies and departments will become more cohesive, universal data-integration networks will evolve.
- **Advanced Manufacturing Solutions** - the greater connectivity and interaction of Industry 4.0–capable machines and systems in their factories, manufacturing-system suppliers will have to expand the role of IT in their products.

3 Discussion

We have created the taxonomy to investigate the most important issues and most used technologies in the field of Industry 4.0 . The taxonomy can be used also as guidelines for resolve Industry 4.0 problems

The generated taxonomy can be used as a search engine at the following link: `https://docs.google.com/spreadsheets/d/1JyHiKv_kBnENtA8yGMV3Sn9x05hKOLJwf49LwdYiEU0/edit?usp=sharing`.

Unfortunately, we were unable to identify a use case for every problem that exists in the industry 4.0 world; however, it is worth pointing out that, among the papers reviewed, Real-time Production Monitoring Analysis, Predictive Maintenance, Smart Scheduling, Smart Warehouse, Cost, and several parts/component reduction are said to be the most frequently addressed problems in the Industry 4.0 world. According to the considered business use cases, white papers, and research articles, the most commonly used enabling technologies are Time-series

Table 2. List of I4.0 enabling technologies.

Horizontal/Vertical Integration	**Industrial Internet**
1. DataBases (a) SQL DB (b) Non SQL DB (c) Time series DB i. InfluxDB ii. Prometheus iii. Graphite 2. Blockchain 3. Connectivity (a) GSM/4G/5G (b) MQTT, Node-Red (c) REST API and Webhook (d) RFID/NFC (e) Bluetooth (f) LPWAN	1. Industrial IOT (a) Industrial communication protocols i. Ethernet Protocols ii. Fieldbus Protocols iii. Wireless Protocols (b) Industrial Gateway and data acquisition device
Big Data and Analytics	**Cloud**
1. Data science (a) Data Visualization and Dashboarding i. Grafana ii. Kibana iii. Metabase (b) Data Analytics i. Data lake and Data Warehouse design ii. Data Mining A. Python B. R C. Julia iii. All-inclusive tools A. Tableau B. PowerBI C. Elastic Stack D. SAP Business Intelligence E. QlikView/Qlik Sense iv. Data Engines A. Apache Hadoop B. Apache Kafka C. Apache Spark 2. IoT (a) Signal Processing 3. AI (a) Machine Learning (b) Deep Learning (c) Reinforcement Learning (d) Continuous Learning (e) Computer Vision (f) Natural Language Processing	1. Container Technology (a) Docker (b) Kubernates (c) Terraform 2. Serverless programming (a) AWS Lambda functions (b) Azure functions 3. Device Management (a) Zerynth Device Manager (b) AWS IoT Device Management (c) Azure IoT Hub (d) WinCC OA IOT OPA 4. Cloud Data Storage (a) AWS S3 (b) Google Cloud Storage (c) Microsoft Azure Storage 5. Edge Computing (a) AWS green grass (b) Azure Edge IoT (c) Custom solutions based on docker swarm (d) Multi-access edge computing (MEC) (e) AWS Wavelength
Advanced Manufacturing Solutions	
1. Embedded Computing (a) Arduino (b) STM32 (c) ESP32 (d) FRGA 2. Sensors (hardware) 3. Signal Processing 4. Blockchain	5. Connectivity 1. GSM/4G/5G 2. MQTT, Node-Red 3. REST API and Webhook 4. RFID/NFC 5. Bluetooth 6. LPWAN

Databases, Industrial communication protocols, Cloud Data Storage, Data Analytics, Data Visualization, and Dashboarding, Machine Learning, and Sensors.

Table 3 shows a ranking of the most commonly used enabling technologies and issues in the industrial sector.

Table 3. The rank of the most used enabling technologies and problems found in articles.

Enabling Technologies	**Number of articles**	**Problems**	**Number of articles**
Time series Database	20	Smart warehouse	7
Data Visualization and Dashboarding	18	Real-time Production monitoring and analysis	6
Cloud Data Storage	18	Cost and number of parts/component reduction	6
Data Analytics	17	Smart Scheduling	5
Sensors	16	Supply chain transparency and reliability improvement	5
Machine Learning	14	Predictive maintenance	4
Connectivity	12		
Signal Processing	11		
Industrial communication protocols	9		

The rank was created by ordering problems and enabling technologies based on the number of articles associated.

4 Conclusions

Industry 4.0 is forming smart factories based on information on demand as a result of the digital transformation, which is transforming the manufacturer journey.
The challenge is to develop new business models and services, and new products to use efficiently the potential that exists from humans and machines collaborate and to optimize the benefits of this collaboration.
Industry 4.0 enables companies to integrate their customers' needs and expectations into their development and production processes in novel ways, such as by direct data sharing with their machinery; it also makes machine data analysis simpler, which improves productivity and prevents production process failures.
To fuel the 4.0 transformation, it's important to provide both the academic and industrial worlds with a clear picture of what's feasible and what's needed to make it happen. This taxonomy is a first step in the right direction. Despite the fact that this is a preliminary exploratory work, it will help in the explanation of the 4.0 environment and open the door to more investigation aimed at better understanding of how the 4.0 world is developing.

One of the possible future works to continue this research it's to create a dashboard with a search engine to query the taxonomy and analyze statistics about it. Another approach to continue the research it's also to make a survey with companies that are adopting Industry 4.0 solutions to analyze the current situation of smart factories.

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Entrepreneurial survivability during pandemic among micro-entrepreneurs

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Abstract. Entrepreneurs' survival strategies in developing economies before and after the Covid-19 pandemic were studied in order to identify micro-enterprises' actual pre- and post-pandemic situations. This paper examines the strategies employed by micro-enterprises to become competitive, the steps taken to overcome barriers and challenges, and the proclivity of companies to capitalize on current opportunities. This paper proposes that David J. Teese's dynamic capabilities theory can be applied through actions such as strategic collaboration with external stakeholders, the adoption of new technologies, ongoing research, and strategic networking. In this sense, knowledge enrichment on micro-enterprise business challenges and the skills they employ during unexpected crises, whether during a pandemic or outside of a pandemic period, can be improved. Furthermore, researchers can benefit from the increased understanding of the significance of dynamic capabilities.

Keywords: Pandemic, Survivability, Micro-enterprises, Dynamic Capabilities.

1 Introduction

The newly discovered Coronavirus (Covid-19) has rapidly spread around the world, affecting the global economy, industries, corporations, and micro-enterprises. Coronavirus first appeared in China and spread throughout the world, with a significant increase in patterns predicted to continue through 2021 without an end date [1]. Developing economies, such as Malaysia, are suffering from the spread of Coronavirus, and many businesses are being impacted by the pandemic's outbreak. Each entrepreneur faces unique challenges, survival skills, and tactics, not only during MCO but also before MCO hits developing economies. Most entrepreneurs, particularly those in micro-enterprises, will cease operations if the MCO is extended, resulting in an increase in the unemployment rate. According to the findings of a survey conducted on one developing economy, such as Malaysia, most businesses are likely to last less than three months if MCO continues [2].

There is no comprehensive statistical or official data on the impact of the pandemic on microenterprises in developing economies. Nevertheless, most micro-enterprises cannot survive without government assistance. For example, the Dewan Perniagaan Melayu Malaysia (DPMM) estimated that more than 53%, or 450,000, of the total 960,000 SMEs registered under the SME Corp have been severely impacted by the

pandemic and will be unable to survive without government assistance. Indeed, most micro-enterprises cannot survive the pandemic for more than two months, but, with government assistance, they could extend that [2]. The evidence is based on the findings of the special Survey (Online) effects of Covid-19 on Economy and companies/business firms, with the majority of respondents being micro-sales companies, with the highest percentage of business firms, 43.4 percent, followed by small-scale enterprises/business firms, at 9.1 percent and 7.2 percent, respectively, and medium and large, at 40.4 percent and 40.4 percent. According to the findings, 53.4 percent of respondents indicated that they could survive if they provided full-time/half-time paid leave to MCO employees. However, 67.8 percent of respondents reported no sales/revenues during MCO, while 12.3 percent of companies/business firms reported revenue from online sales/services and 9.8 percent reported revenue from on-site physical/shop sales. Furthermore, 42.5 percent of respondents estimated that if Covid-19 did not exist, it would take more than six months for their company/business firm to recover as expected. Another 28.7 percent estimated that it would take 4 to 6 months to recover, and another 1.9 percent said that their company/business firm would never recover and would be forced to close. Despite the fact that it is not an official statistic, it can provide an overview of the current situation.

The impact of MCO on micro-enterprises and the survival pattern is critical and should be investigated further for research insights. As a result, this paper is timely to achieve the main objectives: identifying the survival strategies of micro-enterprises during the crisis and providing the researcher with insights on the importance of micro-enterprises having survival strategies. The survival strategies of micro-enterprises during a crisis, and even during a pandemic, must be investigated further. The idea is that the pandemic affects most micro-enterprises, but a small percentage of firms survive the pandemic's extended duration of nearly one year. As a result, the surviving micro-enterprises deemed to have dynamic capabilities that allow them to thrive and survive even during a pandemic crisis.

Furthermore, because micro-enterprises can survive the pandemic, they will be able to survive longer and adapt to the challenging business environment. The impact of the Covid-19 pandemic crisis on micro-enterprises in terms of business continuity and recovery strategy should be investigated further [2]. Furthermore, it is hoped that it will establish long-term support mechanisms for SMEs, particularly during and after the crisis [2]. Government assistance is also important due to the loss of reliance on most small and medium-sized businesses and the need to close some of the premises and bear liabilities if there is no government intervention.

Government assistance is common, as some micro-enterprises reported "zero revenue" following the MCO's total business lockdown. Cash flow imbalances occur because owners must continue to incur mandatory expenses such as employee salaries, business loans, rental fees, utilities, and other fixed costs. Although commercial banks have offered a six-month moratorium period on all business loans, not all businesses are eligible. They use different types of financing, such as financial leasing. As a result, micro-enterprises must be dynamic in order to survive both during and after the pandemic. This can be seen when there is a transformation in the process, efficient resource management, strategies used in order, and effectiveness in addressing challenges.

However, in developing economies, this area of study is still under-explored and thus requires attention.

2 Brief Review of Literature: Covid-19 and Entrepreneurship

To deal with the pandemic situation, an entrepreneurial mindset is required. This means that the entrepreneur must be innovative, risk-taking, and market appropriate. To be more specific, they must consider this from the standpoint of using the social network. They must generate new business ideas and fill a gap in the current market. Being a creative entrepreneur by thinking outside the box and discovering new ways is critical to Covid-19's crisis prevention measures, allowing them to become competitive advantages in the global marketplace [3], [4].

2.1 Impact of Covid-19 on SMEs

A pandemic not only affects public health, but it also has a direct impact on global economies and small and medium-sized businesses (SMEs). The OECD Center for Entrepreneurship, Small and Medium-sized Enterprises, Regions, and Cities (CFE) studied the impact of Covid-19 on small and medium-sized enterprises and observed countries' efforts to improve SME survival strategies. The impact of the Covid-19 pandemic on small and medium-sized businesses is clear in terms of demand and supply, and financial markets will see further declines in confidence and credit cuts. In response to these issues, several policies are put in place, such as temporary tax breaks or direct financial assistance to small and medium-sized businesses. Emerging support packages that anticipate emergency loans to assist SME clients as well as the flexibility to repay existing loans are widely used in Korea, Singapore, and Malaysia. In Italy, the Italian Banking Association, in collaboration with the Business Association, has proposed a large-scale moratorium on the repayment of debts and mortgages, as well as the repayment of small loans and revolving credit lines for businesses, if the government agrees [5].

Non-essential enterprises facing temporary closure and mass movement are prohibited worldwide in response to the MCO. As a result, 70% of small and medium-sized enterprises in developing economies such as Malaysia reported a 50% drop in business within a week of the MCO's implementation. There are, however, a variety of cases involving businesses that use the online platform during this time period. For example, online food shopping increased by 53%, online grocery shopping increased by 144%, and online food delivery increased by 61%. Since the launch of food delivery services with strategic partners such as GrabFood and FoodPanda during the MCO period, there has been a 30 percent increase in orders, contributing to the growth of e-commerce in 2020 [6].

This indicates that the digital economy grows positively during MCO, making it important for small and medium-sized businesses to participate in the digital economy in order to increase their chances of survival and success during the pandemic. The agriculture industry in developing economies, such as Cameron Highland in Malaysia, is the best example of a business that has survived this period of containment. Farmers

were unable to sell their products due to logistical and transportation constraints, and thus had to dispose of them due to storage constraints. Eventually, they turned to other options, such as strategic partners and e-commerce platforms like Lazada, and they were able to sell 70 tons of products in three weeks [6], [7].
Please note that the first paragraph of a section or subsection is not indented. The first paragraphs that follows a table, figure, equation etc. does not have an indent, either.

However, online platforms face challenges because employees must work from home (WFH) during MCO. As a result, 84% of SMEs face challenges during the WFH process due to poor online connectivity [8]. Eventually, productivity is low, efficiency is low, and there is a lack of motivation to do business during MCO. In response to the SME digitization crisis, the Malaysian government launched the PRIHATIN Economic Stimulus Package, which includes 28 initiatives, the majority of which are financial in nature. MDEC has also collaborated with 237 local technology companies, including network providers, e-commerce platforms, and technology service providers, to provide discounts to encourage SME digitization. However, only 25% of Malaysian organizations are successful in response to the PRIHATIN Economic Stimulus Package, while 60% slow down. This indicates that there are obstacles that prevent such efforts from succeeding [9].

2.2 Business Losses Patterns and Industries Affected During the Pandemic

Travel restrictions and aversion to travel risk impacted tourism-related sectors, while interference with production in the global chain was dependent on manufacturing and exports. Economic activity fell as non-essential service providers' operations were halted and manufacturing firms' operating capacity was reduced. Consumption and investment activities have been hampered because social and recreational activities will be limited during the MCO. Aside from that, the commodity sector has been impacted by sharp drops in crude oil prices and volatile fluctuations [11]. Because of declining market demand and supply chains in the seafood industries, the pandemic outbreak had an impact on the aquaculture sector [13]. A decrease in household income leads to a decrease in purchasing power [14]. The MCO's extension has also had a significant impact on the tourism and hospitality industries. Flight operations have been suspended, and employees from various hotels and resorts are entitled to unpaid leave [15]. It had a negative impact on the developing economy. Malaysia recorded significant losses of RM3.37 billion in the first two months of the year 2020 as a result of massive cancellations of travel and tour packages, severely affecting hotels and airlines. As a result, Malaysia's GDP fell from 0.8% to 1.20%, or from RM 10.8 billion to RM 17.3 billion [15]. Researchers proposed that, as a result of the impact of the Covid-19 movement control order, enterprises performing various business activities obtain a broad spectrum of activities, implying that different industries assist researchers in better understanding the study issues [1].

The level of vulnerability varies greatly for low-income workers, minority business owners, and business owners with less educational involvement—minority-owned businesses are particularly vulnerable due to their low sustainability. Furthermore, business owners with a lower education level were vulnerable because their businesses were

in less resilient industries, such as construction and services (repairs, maintenance, and laundry services). Furthermore, 40 percent of small businesses (those with fewer than 20 employees) are more likely to close permanently in the first four months of a pandemic outbreak than firms with 100 to 499 employees with less than 5% of employees [12].

3 Discussion

3.1 Dynamic Capabilities as an Effective Solution for Solving Entrepreneurs' Obstacles

To capture the impact of the recent pandemic crisis on the capacity of developing economies, research is being conducted to investigate the economic crisis effects on SMEs Dynamic Capabilities. According to the findings, micro-enterprises are becoming more effective at utilizing resources and capabilities during times of crisis [16]. Another study looked at the relationship between the digitalization of small and medium-sized businesses and their public crisis responses. The findings revealed that digitalization enables small and micro enterprises to respond effectively to dynamic capabilities [17]. When dealing with a rapidly changing environment, dynamic capability is defined as the ability to build, integrate, and reconfigure internal and external resources. It is critical to the long-term viability of businesses in a changing environment. As a result, crises have created yet another opportunity for businesses to demonstrate their full potential by employing the principle of dynamic capabilities.

There are three emerging dimensions of dynamic capabilities in response to the crisis: the ability to sense the crisis, seize new opportunities arising from the crisis, and reconfigure resources to deal with the crisis. The arrival of the Covid-19 pandemic is undeniably unexpected for all businesses. However, some businesses are aware of the outbreak and believe that the onset of the pandemic will have a significant impact on business. The extent of the crisis will have an impact on day-to-day operations, such as disruptions in production and distribution, market failures, and staff shortages [18]. The greater the likelihood of survival during the crisis. Understanding the crisis is critical so that strategies for responding to the crisis can be developed ahead of time. It may be related to the first dimension of dynamic capabilities in a crisis [17].

When firms engage in dynamic capabilities, the likelihood of identifying new opportunities arising from the crisis appears to be higher. Social patterns are being broken, and new business opportunities are being created. For example, the pandemic's impact on business (some firms had to close) paved the way for the emergence of online business. Adopting dynamic capabilities can result in golden opportunities. As a result, the likelihood of new knowledge from the external environment is relatively high, encouraging firms to rehabilitate their businesses in line with the crisis in order to increase their chances of survival. For example, during a pandemic outbreak, most businesses can be seen providing delivery services due to the situational factors that prevent people from going outside. They can only enjoy the products and services while remaining in a safe zone via delivery. It is a new business opportunity that every company should consider in order to increase revenue [17].

Unifying firms can achieve the third dimension of dynamic capabilities, which is resource reconfiguration. From there, internal and external resources can be mobilized to address the crisis. Researchers agree that the Business Model Innovation (BMI) process is much easier in micro-enterprises than in larger firms because micro-enterprises are much more flexible for BMI to occur. Small and medium-sized businesses, unlike large corporations, can adapt to new rules due to their unique characteristics. According to this paper, firms can improve their performance by implementing a new business model that includes value creation, value proposition, and value capture. However, due to the nature of micro-enterprises, which can generate lower incomes than large corporations, there may not be enough resources and skills. As a result, they are not strategically oriented, and redesigning their entire business model can lead to increased risk, which some cannot bear [19].

4 Conclusion

The importance of dynamic capabilities in micro-enterprises was investigated in this paper. Micro enterprises are important because they create long-term employment opportunities and contribute to developing economies. In this regard, the government should focus more on assisting micro-enterprises to survive in a crisis. Furthermore, micro-enterprises must restructure their operations by implementing necessary improvements, such as digitization. This can be accomplished by collaborating with strategic partners such as Grab, Foodpanda, Shoppee, Lazada, and others. In light of the fact that micro-enterprises are being forced to close their doors due to continuous losses as demand has declined, they must identify various alternatives that are appropriate for the critical situation. It is during a crisis that the full potential of micro-enterprises can be realized. People are aware that the pandemic reduces the likelihood of micro-enterprises surviving; however, micro-enterprises can still make a massive comeback by adapting to market changes. It is therefore critical for micro-enterprises to have entrepreneurial leadership qualities in order for them to survive.

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Challenges of Implementing Zero Waste Strategies in the Gastronomy Industry

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Abstract. This case tells the story of the Café spurlos which aims at becoming a zero waste business and thus making a significant contribution to combating one of the greatest challenges facing society today: the transformation of the economic system into a circular economy. Besides the COVID-crisis and the thereof resulting issues, the café also faces challenges related to its vision of incorporating the zero waste philosophy in its concept. The case explores the complexity of zero waste, analyses further hurdles for zero waste endeavors in the gastronomy industry and illustrates the constant balancing act of social businesses between staying true to one's mission and catering to the needs, wants and expectations of the market.

Keywords: Zero waste, sustainability, gastronomy industry, social entrepreneurship

1 Introduction

It was a beautiful day in February 2020. One of those days that make you aware that spring is just around the corner. Tamara opened the Café spurlos – freely translated to "Café without leaving a trace" – for the first time. It was the start of her mission to run a zero waste restaurant. A place for people to meet, mingle and relax, but also a place where sustainability is in the center of everything. The smell of fresh coffee was in the air and the sound of people chatting and discussing filled the room. That was one year ago. Today, the café is empty. The chairs are on the tables, the coffee machine is still. Far and wide there is not a soul to be seen.

It was most definitely not an easy start for Café spurlos. The COVID-pandemic has hit the gastronomy industry hard. Only a few weeks after its opening, the Swiss government ordered all restaurants to close temporarily. The re-opening was possible later in May, but under strict restrictions. In November 2020, the café had to close down again in face of the second wave of the pandemic. However, the COVID-situation was not the only hurdle for the Café spurlos. It quickly became clear that its vision of becoming a zero waste operation also comes with challenges.

2 Case Study

2.1 The Story of Café Spurlos

That the Café spurlos shall be as sustainable as possible was kind of an obvious decision. The café was founded by and is located within the Impact Hub Basel, a global network of more than 16'000 members in 100 hubs in over 50 countries worldwide. The Impact Hub Basel has the aspiration of supporting a community of social entrepreneurs and sustainable innovators through events, coworking and a variety of incubator and accelerator programs. All of its activities are centered around the UN Sustainable Development Goals (SDGs). It was therefore clear that also its café shall be grounded on those values. However, creating as little waste as possible is an ambitious endeavor that requires a lot of know-how. Thus, the Impact Hub Basel decided to get an academic partner on board to observe and test how their vision could come to life in the most effective and efficient way. That is how the "Zero Waste Innovation Lab (ZEWIL)" was born.

The ZEWIL is a state-funded collaboration between the Impact Hub Basel and the University of Northwestern Switzerland (FHNW). The project aims at supporting economical processes and zero waste innovations in the gastronomy industry, which reduce waste and the overall use of resources. The Café spurlos is at the center of the ZEWIL and all activities of the project are structured into four components. Firstly, "research and documentation", whereby Café spurlos' concept and business serve as a platform and research object at the same time to test, evaluate and analyze zero waste strategies and solutions in the gastronomy sector with the goal of making the Café spurlos a profitable business – from an economic as well as from an ecological and social point of view. This part of the project is under the responsibility of the FHNW. Secondly, the Impact Hub Basel is in charge of the components "education and awareness" and "innovation and experience". Thereby, the Impact Hub Basel organizes events and workshops around the findings of the ZEWIL project as well as an accelerator program for entrepreneurs focusing on zero waste in the gastronomy sector. Lastly, the aim is to develop a scalable business model whereby the acquired knowledge can be implemented in the industry through consulting services or similar.

Tamara was very excited to be a part of the ZEWIL as the manager of the Café spurlos. She had previously worked in the gastronomy industry, but it was always her desire to make more of a difference with her work. The ZEWIL seemed like just the right opportunity to do so. She was highly motivated to start this journey towards a zero waste operation and was very happy when Simon joined to support her in the management of the café.

Fig. 1. Tamara and Simon

2.2 Zero Waste – What Does That Actually Mean?

Besides the resulting issues of the COVID-situation, Tamara and Simon also soon faced the first challenges related to their task of incorporating the zero waste philosophy in their concept. Zero waste is not a protected term and as a result, there is no universal definition of it. Therefore, the first question that arose for Tamara and Simon was: “What does it mean to be a zero waste restaurant?” The most widely used and accepted definition of zero waste was developed by the Zero Waste International Alliance (ZWIA) in 2002 and has since been further elaborated. The most current version is as follows:

"Zero Waste: The conservation of all resources by means of responsible production, consumption, reuse, and recovery of products, packaging, and materials without burning and with no discharges to land, water, or air that threaten the environment or human health." [19]

Therefore, zero waste maximizes recycling, minimizes waste towards zero, decreases consumption and strives towards products that are designed to be reused, regenerated, repaired and recycled internally or back into nature or the marketplace [9]. However, zero waste focuses on all kinds of resources and is therefore closely related to the concept of sustainability, which aims at respecting environmental, social and

economic aspects simultaneously. Also, zero waste refers to the entire value chain of a product – from sourcing all the way to the disposal – and hence also is in line with circular economy principles. Furthermore, the definition of zero waste has evolved over the years and the focus has shifted from recycling to maximizing the reuse of materials and the efficiency thereof.

Moreover, the Zero Waste International Alliance also developed the "Zero Waste Hierarchy", which describes a progression of policies and strategies to support the zero waste system, from highest and best to lowest use of materials [18].

Fig. 2. The Zero Waste Hierarchy 7.0 [18]

While the “Zero Waste Hierarchy” was developed for general application, there are no further guidelines around the concept specifically tailored to the gastronomy industry. More so, zero waste is often equalized with food waste. However, zero waste goes much further than that and includes the conservation of all types of resources involved and used in a restaurant operation – not solely food.

2.3 When Complexity Makes Things Complicated

The managers of Café spurlos began to realize that their ambition of opening a zero waste café was a lot more complicated than they had initially thought. The complexity of the zero waste concept and the fact that the entire value chain of a product has to be considered in order to evaluate its level of sustainability makes it very hard to incorporate and respect zero waste principles in all decisions and activities, Tamara elaborates. Often it is very non-transparent how, where and under which circumstances a product was produced, transported and processed. Really digging into this information is not only complicated, but also extremely time-consuming and not rarely simply impossible. Hence, just sourcing "standard" products from large suppliers is simply the easiest and fastest way. That is one of the reasons why Tamara and Simon think that joining forces is crucial for the gastronomy industry in its striving towards a more sustainable future. At the moment, there is no real sharing of knowledge between hospitality organizations around the topic. That is particularly relevant given that the hospitality industry in Switzerland is a distinct SME sector, dominated by independent micro-enterprises with only very few employees [15, 7]. As a result, those types of operations also only have very little negotiation power in terms of sustainability and zero waste policies, regulations and standards with their respective suppliers. Moreover, it cannot be overlooked that the effort for sourcing a product does not depend on the purchase quantity. Making sure the 2 kilograms of apples you sell in your café per week are as sustainable as possible does take as much time and effort as when you sell 100 kilograms per week. That makes it even more challenging for small operations like the Café spurlos to be truly "zero waste".

On top of that, legal requirements, particularly related to food safety, often stand in the way of making a restaurant operation more resource-efficient. Simon explains: "Even if you are very determined to reduce food waste, it is not easy. The options are limited because under the Swiss food legislations, food that has been presented on a buffet has to be tossed after a certain amount of time and leftovers from i.e. a catering cannot be re-sold." While those restrictions may make sense from a food safety point of view, they definitely hinder the gastronomy industry in its sustainability endeavors.

2.4 Determining What Is Right

How challenging the complexity of zero waste is became especially visible in the development of the café's offer. In the conceptualization process, Tamara and Simon asked themselves what products they actually want to put up for sale and according to which standards and criteria they should be chosen. When looking at the "Zero Waste Hierarchy" pyramid, they realized that they were currently on the first stage of the process: "rethink and redesign". They were trying to put together an offer that conserves and protects all resources in the sense of the zero waste concept. "What even is a zero waste offer? What is a sustainable diet and what would a sustainable food system look like?", were questions the managers of the café asked themselves. That is when it became apparent how difficult it is to assess the "sustainability" of a product in its entirety, since that is the result of the simultaneous consideration of ecological, social and

economic factors. According to the FAO, economic impacts on sustainable food systems are i.e. profits, generated jobs, tax revenues or food supplies. Environmental impacts can i.e. be the carbon and water footprint, soil health, animal health, food waste, biodiversity or toxicity; whereas social impacts to be mentioned are i.e. added value distribution (gender, youth, indigenous people), cultural traditions, nutrition and health, worker rights or animal welfare [6]. Thus, all of those factors have to be respected and catered to at the same time in order to be as sustainable as possible. Moreover, at the 2010 conference "Biodiversity and Sustainable Diets: United Against Hunger," jointly organized by FAO and Bioversity International, the following definition of sustainable diets was agreed upon:

"Those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources." [5]

It thus became clear that due to the various factors that need to be taken into account, it is very difficult to establish blanket "rules" that make a culinary offering sustainable. However, three main guiding principles have been identified to be efficient in terms of optimizing the use of resources from a scientific point of view:

1. **Plant-based:.** In order to reduce CO2 emissions as much as possible, a largely "plant-based" food offer is key. Undoubtedly, meat and dairy products cause by far the highest CO2 emissions of all types of food [14]. Particularly beef has an unsurpassable impact on the planet's greenhouse gas emissions and also requires more water and land in its production than any other single food product [1]. However, when it comes to nutrition, health aspects naturally also play a central role. The EAT-Lancet Commission looked into this very issue and researched what a "Planetary Diet" - a diet that simultaneously offers the most benefits for the environment and for people - should look like. Such a diet should optimize health and thereby enable people to be in a state of complete physical, mental and social well-being while the respective food production should stay within the boundaries defined in order to decrease the risk of irreversible and potentially catastrophic shifts in the Earth system. The Commission concluded that such a diet should be largely plant-based flexitarian and include only a small amount (approximately 13% of the daily caloric intake) of animal products [3].

2. **Seasonality and Regionality:** There are two types of seasonality: globally seasonal (i.e. produced in the natural production season but consumed anywhere in the world) and locally seasonal (produced in the natural production season and consumed in the same region) [11], which is why seasonality and regionality go hand in hand. One would assume that locally seasonal produce is more beneficial from a sustainability point of view. Generally, that is true given that globally local products can have a high environmental cost in the country of production in terms of water or land usage. But the reality is not that simple. Those foods also come with nutritional benefits since they offer a more varied and consistent supply of fresh products all year around

[11]. Moreover, it is widely believed that transportation is a main contributor to the ecological footprint of produce. Research shows that air transport in particular indeed has a strong impact on the ecological balance. However, the vast majority of goods from overseas are transported by ship, which does not have a particularly relevant impact on the footprint [13]. Another factor that can impact the eco-friendliness of seasonal food is whether or not the products were grown in a heated greenhouse [2]. Moreover, the consumption of globally seasonal produce might also support communities in producing countries that highly depend on agricultural trade. However, such food might often be produced under more than problematic working conditions.

That illustrates how many small factors determine the sustainability of a product and thus also makes clear that what is the most resource-friendly option has to be evaluated on an individual case-to-case basis. Overall, it can be said that the consumption of seasonal and local produce only matters little for total CO2-emissions. The choice of the actual food holds definitely more importance in that regard and a more plant-based diet will therefore always have a much larger impact regardless of seasonality and regionality of the products [14]. However, if one really wants to make difference, one also needs to take care about what animal products are replaced with and under which environmental and social circumstances those have been produced [1].

3. **Fair Production:.** Under which conditions food has been produced and whether or not those circumstances can be considered humane, inclusive or fair is extremely hard to evaluate as a consumer and as a restaurant manager alike. However, operating under zero waste principles also includes using human resources as efficiently and sustainably as possible. Therefore, protecting workers' rights and paying adequate salaries to producers are crucial factors [4]. The easiest way to ensure those requirements are met, are respective certifications such as i.e. Fair Trade. However, the vast number of labels and standards arguably guaranteeing fair production can be overwhelming and their effectiveness hard to assess. On top of that, they also come with drawbacks. Producers must meet increasing requirements for certification which comes at a price that is often not feasible for small businesses and farms in developing countries [17]. On the other hand, that of course also results in higher purchasing and respective selling prices of the food products.

2.5 Zero Waste Can Never Be Perfect

When taking a closer look at those three guiding principles, Tamara and Simon learned quickly that in the context of sustainability and zero waste, there is a counter-argument for everything. The vegan diet is the most ecological, but not necessarily the healthiest one. Organic meat is better for animal welfare, but causes more Co2-emissions per kilogram compared to meat from conventional production. Consuming products from overseas is not necessarily environmental-friendly, but supports communities that highly depend on the export of their agricultural produce. It became obvious that zero

waste can never be objectively perfect. Given the interdisciplinary nature of the sustainability concept, which aims at respecting ecological, social and economic factors equally and at the same time, there will always be certain compromises that have to be made. Moreover, the café also faced the challenge of being economically profitable while incorporating the philosophy of zero waste. “The quality has to be right. If the coffee is super sustainable, sourced fairly and served in a reusable cup but then tastes like crap, nobody is going to come”, says Simon. Moreover, guests also have certain expectations. Even though coffee has to be imported and production conditions might often be critical, it is a product that undoubtably has to be part of the offer in order for a café to have a chance to be financially successful. The same goes for having a largely plant-based offer. The managers had sincere doubts that their customers would be satisfied with a menu largely free of any animal products. Those dilemmas between customer expectations and sustainable management practices have also been studied in scientific literature. A recent study i.e. has found that particularly young employees in the hospitality industry are eager to incorporate eco-friendliness and thus highly motivated to reduce food waste. However, in pursuit of customer satisfaction through fresh produce, they tend to accept and follow the given cultural workplace waste norms – which do not necessarily aim at reducing food waste - despite their actual beliefs [10].

Tamara and Simon also came to realize that depending on the quantity, sourcing locally can be challenging. Regional produce is limited and therefore, larger amounts are often not available. That makes the sourcing process unpredictable, unreliable and thus even more complex, which can easily scare off restaurants trying to be more sustainable. Sourcing foodstuffs from fair production was important to the café managers too. However, they were also aware that guests are only willing to pay a premium for a sustainable product up to a certain degree.

Undoubtedly, to guarantee that a product is truly and fully sustainable, supply chain transparency is key [8]. The process that a product has undergone before it ended up on a customer’s plate needs to be traceable to ensure that it corresponds with the desired ecological and social standards - and hence zero waste principles - along the entire value chain. Given the immense amount of information and the high level of complexity, that is anything but an easy task. However, recent research suggests that Blockchain technology might be a well-suited tool to enable traceability – and hence transparency – of supply chains [i.e.16]. Moreover, it has been found that Blockchain hence has the potential to increase supply chain sustainability performance [12]. It therefore seems like technology and respective systems hold great potential to profoundly influence the way in which decisions over resource use and commodity trade are made [8] and could therefore also dismantle at least some of the barriers in terms of implementing zero waste strategies in the gastronomy sector. i

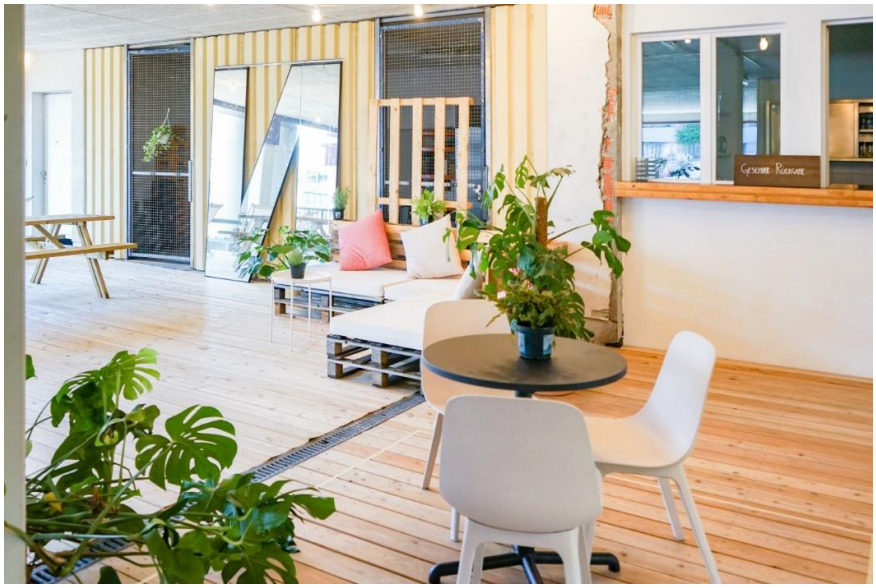

Fig. 3. The terrace at Café spurlos

2.6 Excited for the Future

The complexity and the simultaneous interaction of so many individual factors became more and more overwhelming and challenging the further the conceptualization process of the Café spurlos progressed. Evidently, being a zero waste operation is a constant balancing act between staying true to its mission and cater to the wants, needs and expectations of its customers. Also, it became clear to Tamara and Simon that zero waste has boundaries and they have learned quickly that frustration is now part of their job description. However, Tamara says, "zero waste is a matter of the heart. Our motivation is intrinsic, we do this because we believe in the cause, because we want to make an impact."

Now, in spring 2021, it seems like there is finally light at the end of the COVID-tunnel. The Café spurlos team has made the best use of their forced break and worked out a solid concept for their business. "Once everything is back to normal, we will hit the ground running. This is what we are passionate about - it's as simple as that", Tamara concludes. If only it was.

3 Teaching Notes

3.1 Learning Outcomes

The objective of this case study is to expose students to the concept of zero waste and the implementation thereof in the gastronomy industry. Moreover, they will examine the complexity of the zero waste concept and learn more about the challenges and hurdles on the way to incorporating the zero waste philosophy.

3.2 Questions

1. What are the main challenges of conceptualizing a zero waste café?
2. What next steps could Café spurlos take towards their vision of becoming a zero waste operation?
3. To what extent do you think zero waste is achievable and what role does that play in the context of sustainability overall?
4. How do you think the COVID-crisis affects the zero waste movement in the gastronomy sector and beyond?
5. How could technology and particularly the integration thereof help overcoming the identified challenges and make the implementation of zero waste principles more effective and efficient?

3.3 Model Answers and Analysis

1. What are the main challenges of conceptualizing a zero waste café?

The challenges are manifold. Firstly, the fact that "zero waste" is not a protected term and its definition therefore somewhat subjective makes it challenging to even establish the determining factors of what a zero waste café should be and what requirements it should fulfil. Even if one was to come up with a definition, the communication thereof to the customer remains challenging. Another significant hurdle is the complexity of zero waste. The fact that the entire value chain of a product has to be considered in order to evaluate its level of sustainability makes it very hard to incorporate and respect zero waste principles in all decisions and activities. Moreover, information regarding the sustainability of products is untransparent and thus difficult and time-consuming to gather. On the other hand, zero waste centers around reducing all kinds of resources. Hence, social, economic as ecological factors have to be respected simultaneously. As a result, there is a counter-argument for nearly anything in the context of zero waste. On top of that, due to the small-structuredness of the industry, implementing zero waste practices is time-consuming and can potentially be frustrating due to little negotiation power and impact on policies and regulations. Also, there are certain legal requirements that might stand in the way of becoming a more sustainable operation.

2. What next steps could Café spurlos take towards their vision of becoming a zero waste operation?

This question could be answered in many different ways and might stimulate creative solutions and approaches. Potential directions could include the development of a clear concept and a definition of what a zero waste café is in that context, goal setting, measuring waste, community building with other players in the industry, entering partnerships or the development of a circular system. This question might also be a good opportunity to start a discussion around what requirements a zero waste café should fulfil and what social, ecological and economic factors should be considered simultaneously.

3. To what extent do you think zero waste is achievable and what role does that play in the context of sustainability overall?

The case of the Café spurlos has clearly shown that zero waste can never be perfect because of the complexity of the concept and the many different aspect that have to be combined and respected simultaneously. Also, the term zero waste can be confusing because not creating any waste at all seems somewhat utopian and unrealistic. However, the hierarchy of zero waste might be a good indicator of prioritizing different zero waste strategies and might be the best way to optimize one's waste generation and management.

Zero waste is very closely related to the concept of sustainability. In order to achieve sustainability, zero waste practices are inevitable. Therefore, the challenges of implementing both concepts are also very similar. Just like zero waste, sustainability is highly complex and requires to combine a variety of aspects.

4. How do you think the COVID-crisis affects the zero waste movement in the gastronomy sector and beyond?

On the one hand, the COVID-outbreak and the resulting crisis might have increased the awareness for sustainability-related issues and at the same time strengthened people's appreciation, consciousness and mindfulness for both nature and social community. Those changes might also be translated into the gastronomy sector and increase the activities and endeavors related to sustainability and zero waste. On the other hand, the new requirements, circumstances and habits due to the COVID-situation definitely also had negative impacts in terms of waste creation. In the gastronomy industry, especially one-use hygienic items such as masks, paper towels or gloves generate a considerable amount of waste. Not to be forgotten is the take away packaging that has become crucial during COVID and obviously is a very wasteful practice as such.

5. How could technology and particularly the integration thereof help overcoming the identified challenges and make the implementation of zero waste principles more effective and efficient?

One of the main challenges that Tamara and Simon encountered is the complexity of zero waste and particularly the non-transparent supply chains that make it hard for them to truly assess whether or not a product really complies with Café spurlos' philosophy and requirements. The traceability of food products as well as the evaluation and prioritization of sustainability criteria requires highly specialized knowledge and is also a very time-consuming process. Thus, it is evident that the complex system of different factors that influence zero waste strategies in the gastronomy industry need to somehow be connected and analyzed in a structured and automated manner. This shows the importance of technology integration and particularly the need for a system of intelligent technology in connection with human society to tackle sustainability issues.

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Prospective Synergy Between Bangladeshi SMEs and Smart City: Through the Lens of Society 5.0

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Abstract. Rapid urbanization in the emerging markets necessitates utilizing the scarce resources more reasonably and sustainably, for which technology adaptation is imperative. Despite this, the emerging markets suffer from weak technology and lag from realizing entrepreneurial opportunities inspired by a human-centric concept of Society 5.0. The key research aim is twofold. First, to explore the possibilities of transforming the emerging markets into smart cities in Bangladesh. Second, the potential of introducing and operating Smart SMEs in the smart cities as a pre-condition to embrace Society 5.0 for ultimate wellbeing for humans across the emerging economy. The study adopts a clustered content analysis method, followed by collection and classification of the relevant extant literature on the urbanization status of Bangladesh, Smart City, and Society 5.0. The literature review suggests that, with the right digital solutions, Society 5.0 may inspire to build a more versatile set of SMEs of the future: Smart SMEs. The study formulates a framework addressing Society 5.0-inspired Smart City's potentials in the emerging markets to create Smart SMEs. The study pioneers in offering Smart SMEs approach to fit in the concept and proposes a new definition of 'Smart City' based on its rapport with emerging markets. The study foresees a meaningful implementation of Society 5.0 to create transformational value among other emerging Asian nations, including Bangladesh. New directions of future research to empirically test the connections to address diverse social and human needs are also suggested by the study.

Keywords: Smart City, SMEs, Society 5.0.

1 Introduction

On the edge of Industry 4.0, the Emerging Markets (EM) have turned into melting pots for entrepreneurs. The vision of creating a more equitable, livable, and sustainable world has led the researchers to accentuate the multidisciplinary approaches of EM [1]. Urbanization in the EM is among the critical processes that deal with the urban concentration of the population. The exponentially growing city-based population must adapt to EM's technology for using scarce resources more reasonably and sustainably. The

competitive edge of a city often is reflected by its novelty and economic sustainability. The cities from the emerging markets have been implementing ICT and other networked infrastructure to ensure more incredible business growth among the SMEs and the large incumbents to stay competitive. This competitive move leads to more significant entrepreneurial activity in a Smart City [2].

With better flexibility and adaptability, SMEs can play a critical role in boosting productivity and economic growth and equalize income distribution [3] in the urbanized economy. Those emerging markets often embellish the concept of Smart City [4], which has been acknowledged as highly entrepreneurial by scholars and policy-makers [5]. The nexus between city-based economy and entrepreneurship remaining multidirectional, the SMEs complements well with the smart cities [6]. Nevertheless, an analysis of SMEs' interaction and emerging economies, especially from Bangladesh's perspective, has been missing. This paper seeks to address the research gap by observing this relationship from the lens of Society 5.0, a human-centric approach for economic advancement. The study aims to address the social needs, which is a timely research-requirement.

2 Literature Review

2.1 Urbanization in Emerging Markets

Emerging Markets (EM) denotes a developing economy that progresses to a futuristic industrial economy from an agricultural and resource-dependence economy often followed by the industrial revolution. EM is characterized by unique features such as vast disparity of growth rates in urban and rural market growth rates, the evolution of socio-cultural trends, the emergence of bureaucratic and corrupted systems, and diffusion of innovations. Given the distinctive challenges and opportunities, EM is substantially differentiated from the developed markets. By investing in education, infrastructure, defense, social programs, EM aims for creating faster GDP growth, greater connection with global markets, and a better standard of living [7].

On the other hand, urbanization in the EM refers to a social process that triggers the urban cities to grow and the societies to adopt city-based lifestyles and culture with the migration of the population from rural to urban areas. Global urbanization is led by the rise of city-based world population from 30 percent in the 1950s to 50 percent in 2011. It is predicted to rise to 70 percent before 2050, according to the United Nations report (2012), and this is more prevalent among the emerging and developing economies [5]. In 2020, the urban-dwellers were 38.2 percent of the population of the developing and emerging country, Bangladesh. The urban population is growing at a 1.9 percent rate [8]. Despite the faster urbanization in Bangladesh compared to the other South Asian countries between 2000 and 2010 [9], the country has experienced messy urbanization, with some 47 percent of the urban population belongs to slums [10]. In terms of the 2020 global livability index, Dhaka has been positioned as the 3rd among the worst cities [11] [12].

To overcome rapid urbanization challenges, including resource-scarcity and infrastructural inadequacy [13], SMEs can enhance their GDP contribution. To realize the value and potentials of SMEs in Industry4.0, adopting new technologies is imperative.

SME entrepreneurs need to emphasize updating their technical and data-related skills to operate in dynamic and competitive environments. At the global level, about one-third of the skills are subject to be obsolete following the skill-disruption trends over the next half-decade [14]. The universities, SMEs, corporations, and citizens should enthusiastically participate in the skill up-gradation process. It can be inferred that a successful implementation of smart cities will work as a catalyst of SME development in Bangladesh's emerging economy.

The recent trends indicate the readiness of Bangladesh to create emerging markets. Besides standing as the fastest growing economy of the Asia-Pacific; stable governance and policies regarding taxation, economic, and foreign trade, the low-cost labor, and a gradual shift towards information and communication technology (ICT) industry and renewable power sources have played a significant role in forming its economic foundation [15]. Consequently, the mobile-friendly internet connection is accessible to general people with 4G internet since 2018, which is expected to reach 51 percent by 2025 [16]. Another critical aspect of smart cities is cashless to ensure efficiency [17] To convert more than 70 percent of Bangladesh's unbanked population [18] to cashless, mobile financial services are contributing to creating financial inclusion [19] among 50 million users, followed by a rise in mobile application-based services.

These changes make the lives of the users easier and prove to be a source of employment for Bangladesh's workforce. Another commendable act by the government of Bangladesh is the increased incentive (20-45 percent duty) to use fuel-efficient and environment-friendly hybrid cars instead of regular ones (100-300 percent duty) [20]. In the emerging markets, smart cities' creation will enhance urbanization and make the cities more livable [4]. As a consequence of such a digital revolution with urbanization, the Smart City concept's interest has grown immensely. The information and communication technologies (ICT), policies based on high-tech infrastructures, and city-dwellers efforts to enhance the quality of lives have improved possibilities for cities to organize urban growth [2].

2.2 Smart City in Emerging Markets

A visionary goal of emerging markets to become a Smart City or even a Super-smart City leads the emerging markets' entrepreneurs to adopt robust and prudent means to use technology. The governments of many emerging markets have been progressing to create smart cities. Some 26 megacities from the largest emerging markets in the ASEAN region, including Singapore, Java, Bangkok, Jakarta, and Manila, have adopted the smart city concept, and most of them have started to experience the significant value of their investments already [4]. Therefore, the term 'smart city' has turned into a trailblazer that could be adopted in renovating the emerging markets. Nevertheless, the concept remains a fuzzy buzzword [21]. Some related terminologies such as eco-city, sustainable city, digital city, intelligent city, or knowledge city are often analogous to the concept. The concept's reasons to lack unanimity are that most of the definitions are centered on either technology or smart human-resources or smart collaboration between government and citizens [22], or even customer-centricity [4]. The following Table 1 offers different perspectives offered by various authors on the concept.

Table 1. Different Perspectives of Smart City.

Authors	Viewpoints of various authors
Giffinger et al. (2007)	A forward-looking and well-performing city with a set of intelligent features including people, environment, living, agility, governance, and economy, built by self-decisive and conscious citizens [23].
Caragliu et al. (2011)	A city that invests in human capital, social capital, traditional infrastructure, and modern communication infrastructure (ICT) and manages natural resources with participatory governance to fuel economic sustainability and quality of life [24].
Lombardi et al. (2012)	A city that generates intellectual capital, wealth, and regulations for university, industry, civil society, and government while stimulating the abilities of presupposition and knowledge-transmission as a prerequisite to innovation systems [25].
Bakici et al. (2013)	A city that actively generates innovative ideas by nurturing clusters and promoting 'living labs of competent citizens to co-create products or services [26].
Richter, Karus & Syrja (2015)	A clustered area of high concentration of novel knowledge by creative citizens and institutions and implementing a digital infrastructure aims to achieve economic sustainability and high quality of life concerning natural resources scarcity [5].
Lara et al. (2016)	A domain consisting of smart concepts including technology, transport-system, health-service, governance, and economy [27].
Angelidou (2017)	It promotes various phenomena, including technology-centric, human resources and entrepreneurs, information security, privacy, social status, management, networking, strategic framework, interdisciplinary arrangement, and generic collaboration [28].

The collaboration of private players, people, and policy-makers is a mandatory prerequisite to positively impacting smart cities [29]. The creative citizens often turn themselves to visionary entrepreneurs with IoT-based infrastructure [30]. Smart cities offer avenues for creativity, innovation [31], and entrepreneurial opportunities, followed by the profound rise of consumption and production patterns. While the ICTs and other network infrastructure direct the SMEs to realize new opportunities, they create new markets [32] and commercialize new ideas [29]. The policy-makers, corporate entrepreneurship [33], and citizen-led enterprises [30] play an enriched role in converting the emerging market into Smart City. Features specific to smart cities, including big data or open data, would foster open governance, accountability, transparency, citizen engagement, and economic progress. The infrastructure and entrepreneurial opportunities [34] and greater access to data lead to the uninterrupted creation of new firms [25] and turns the cities into seedbeds for innovation and entrepreneurship [5].

Nevertheless, as the emerging markets such as Bangladesh are still lagging due to the absence of a feeble technology-base to realize the Smart City concept fully, necessary policies should be introduced to accentuate protecting citizens' rights so that technology never supersedes humanity [20]. Therefore, a human-centered approach is what the emerging markets need to add to the Smart City approach.

2.3 Society 5.0

The most enhanced version of contemporary and human-centric society is Society 5.0, which emerged as Japan's strategic national political initiative to balance technological instruments of big data, AI, IoT, and robotics with economic growth resolve societal issues [35] [36]. It seeks to improve productivity via the digitization and redesign of business models and simultaneously builds society with innovation and globalization [37]. Society 5.0 is a process of value-addition to industrial and societal aspects [38]. The Sustainable Development Goals (SDGs) that focus on attaining sustainable humanity by mitigating their social problems complement Society 5.0.

To succeed, Society 5.0 needs to accentuate human control by integrating innovation policy (government), entrepreneurial spirit, and skills (civic society and innovative institutions) [39]. The transformation is expected to help humans live their lives easier and faster, greatly assisted by technology. Business transformation is accelerated by and built upon digital technologies and supports the businesses' experience more remarkable growth. Japanese Robotics market is anticipated to stand at USD 87 billion in 2035 from a mere USD 9 billion in 2010. Many Asian countries, including Malaysia, Singapore, Indonesia, are aiming towards a new human-centered society [40].

3 Methodology

The study objective is to address the nexus between SMEs and Smart City to create pre-conditions for Society 5.0 for humans' ultimate wellbeing. The study conducts an extensive review of the current literature, and the process is consistent with Richter et al. (2015) [5]**.** The study specifically seeks to understand the impact between SMEs and Smart City (see Fig. 1).

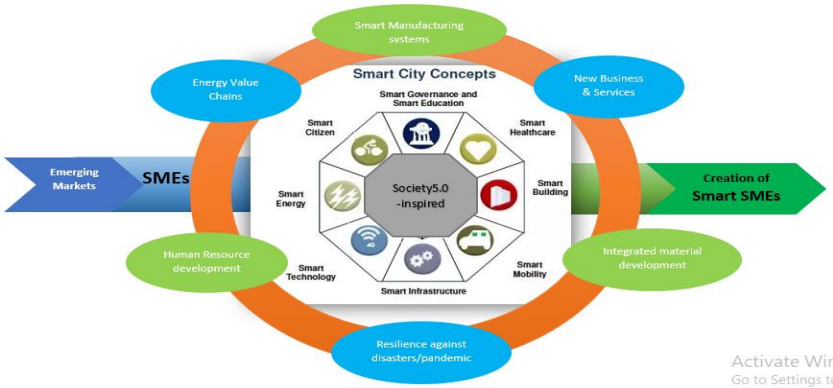

Fig. 1. Prospective Synergic Effect of Smart City among the SMEs.

A clustered content analysis method has been adopted as the study aims to investigate a research-domain that is not yet systematically studied. Based on the existing literature, the study will use a method to advance understanding of the phenomenon

and open up research avenues. A comprehensive analysis of Smart City's three-dimensional themes, SME 5.0, and the urbanization and economic status of Bangladesh has been conducted. The most relevant literature, published articles, conference proceedings, and book chapters have been considered for this purpose. Since the Smart City is an emerging yet trans-disciplinary approach with no established research-base, various management, economics, and business journals were considered accentuating urban communications, urban technology, and human resources. The present review was conducted in three stages [2]:

1. Searching of articles through Emerald, Google Scholar, ProQuest, and Web of Science databases using a set of search phrases such as "Society 5.0", "smart cit*", "SME and Urban Cit*" and "Bangladesh urban econom*" to identify relevant sources of information until 2021. The peer-reviewed articles were the prime focus.
2. Classification of the articles by further narrowing down the data set. It was ensured that those data set contains either of the terms, such as *entrepreneur, firm, SME, small business*. The stage further furnishes two different sets of articles on entrepreneurship (SMEs) and smart cities.
3. Clustered content analysis was conducted to explore emerging markets' entrepreneurial context to understand SMEs' influence on smart cities. The insights of the articles were divided into three distinct research-streams: (a) Urbanization, (b) Emerging Markets, and (c) Smart cities.

4 Discussion

4.1 SMEs through the lens of Society 5.0

To ensure human-centered problem-solving and value creation, a smooth merging of the "people with things" and the "real with virtual" worlds is necessary. This fuse will lead to transformational advances to various prolonged societal problems prevailing in the emerging economies. All related stakeholders of economic growth across the globe, including the governments and firms, anticipate the smart urbanization and technological changes will continue to trigger a positive environment for adopting Society 5.0 within the next few years by the emerging markets, which have been experiencing synchronized and real-time revolutions from the industrial and urban aspects. These revolutions accompanied by increased inter-relations and intra-relations among people and data will accelerate technological advancements. The robust shift towards the digital age has been occurring ten times faster and three hundred times the scale of the Industrial Revolution's societal transformation, leaving some three thousand times impact on human lives [41].

Society 5.0 can be a suitable catalyst to renovate and upgrade SMEs by empowering them to enhance the quality of life instead of just boosting technology's impact. Various concepts such as big data, the Internet of Things, and artificial intelligence are anticipated to convert to pearls of new wisdom through the process. Such revolution is necessary to create corridors of humanity and equity [42]. The possibilities created by the Japanese phenomenon are expected to address individual needs and resolve social problems from diverse-levels. As a result of its significant influence, the other Asian nations, including Bangladesh, can be hopeful to experience Japan's super-smart society's

transformational benefits, and the citizens may lead their lives easier, better and faster. To better respond to the challenges imposed by the messy urbanization and provide a tailored solution to the customers in the emerging economies, the citizens deserve a thorough understanding of smooth transition towards Smart City's concept with the light of Society 5.0 [43].

4.2 Potentials of Smart SMEs in Bangladesh

SMEs, as the economic backbone of an economy, enhances sustainable industrialization and employment. The contagion of the COVID-19 presents a significant threat to the SMEs of Bangladesh, requiring interdependencies among business, nature, education, and society to develop a readiness to operate, grow, and survive in the post-covid economy [44]. With a greater approachability towards financial sources, social and professional networks, or entrepreneurial capital, the emerging markets can be expressed as smart cities for a one-stop-solution to innovation, productivity, humanity, and equity. The high-end resources, production factors, and the supply chain network's intellectual capital have remained conducive to business growth. The favorable business-environment further reinforces Smart City's competent vehicle-set, including the regulatory institutions, training establishments, public transportation, and healthcare [13]. Also, to be more responsive to citizens, the smart cities may adopt a quadruple-helix model, where (a) the government by allocating resources and planning policies, (b) corporations and universities by creating more experience, expertise, and know-how, (c) SMEs by initiating small-scale social improvements, and (d) the smart citizens by addressing various issues to resolve sustainably [30] [45].

Given the correlation between SMEs and emerging markets, the present study suggests a revised definition of Smart City: "a concept that instigates productivity, sustainability, equity, and livability among the citizens by giving them a voice and among the creative entrepreneurs by giving them opportunities to use digital infrastructure, all while keeping in mind about resource-limitation". If Smart City's concept is applied adequately and correctly in Bangladesh, the higher spatial and contextual proximity among the ventures will lead to knowledge spillovers. This implementation may effectively open the corridor to commercialization opportunities of innovation. The scenario, in turn, would lead to tremendous business growth and an 'innovative spirit' [46] among the SMEs. With the right digital solutions offered by the Smart City, the SMEs would be better able to fine-tune the 'innovative spirit', scale up their businesses, respond to the dynamic customer demands, and build a more versatile set of SMEs: Smart SMEs [40].

A combination of ICT, business-led urban development, government, and policy-makers will turn the Smart City of Bangladesh into a center of entrepreneurship and homeland of Smart SMEs [26]. Also, by acknowledging the resource-limitation of the urban cities of Bangladesh, the characteristics of social and environmental sustainability of Smart City will help create entrepreneurial opportunities for the Smart SMEs [2]. For the Smart SMEs to be effective, the Smart City must complement the knowledge-intensive sectors such as creative and tech-based industries. Also, as the knowledge-creating networks are primarily based on transferring and adopting tacit knowledge, the Smart City should connect with 'living labs' consisting of highly-educated

entrepreneurs [47]. The capital city Dhaka and port cities such as Chittagong, Khulna, and Sylhet offer more forward-looking possibilities for Bangladesh's economic activities and are among the fore-runners to embrace the Smart City concept.

4.3 Realizing Society 5.0 by Smart SMEs

To add value and realize the concept of Society 5.0 of a human-centric growth strategy, the entrepreneurs need to generate quality data first. By ensuring effective rapport between cyberspace and physical space [48], the Smart SMEs and Society 5.0 can be catalysts to each other. The growth of Smart SMEs can lead to market creation and economic development for smart cities. By realizing the benefits of Society 5.0 and operating in the smart cities, the limitations associated with spatial, socio-cultural, and financial factors are expected to reduce. Also, adopting innovative business models would trigger economic growth. Thereby the scope of Smart SMEs would be heightened in the emerging markets of Bangladesh [49].

For a resource-scarce economy like Bangladesh, rather than aiming to create unicorn startups with exponential-growth, dominating, and competitive attitudes, as coined by Aileen Lee in 2013 [50], the smart SMEs should emphasize being zebra SMEs that are sustainable, mutualistic, and promoters of social wellbeing with regenerative growth [51]. Initiated by four women entrepreneurs, as mentioned in the book named, “Starting a Revolution: what we can learn from female founders about the future of business” [52], the 'zebra movement' can be an excellent example for the women-owned SMEs as well. Smart SMEs are expected to arch their massive impact in the urban economy, being empowered by the big data revolution. Also, tapping into a rising consciousness among all the stakeholders, the SMEs could better tackle socio-economic challenges coinciding with the SDGs.

5 Conclusion

Being crucial actors and architects of the future Smart City in Bangladesh's emerging markets, the SMEs should make a conscious and continuous effort to collaborate the social and business welfares. By embracing technology and networked infrastructural makeover, the SMEs can turn to tomorrow's Smart SMEs to address the citizens and society. The values and promises of Society 5.0 are expected to eradicate the gaps associated with gender, language, culture, and region and address individual needs from diverse-levels. The SMEs being flexible, competent, and versatile sectors of the economy, can serve as catalysts towards an extraordinary digital transformation. Effective utilization of Smart SMEs will lead to greater sustainability of the smart cities. Considering the strong interdependences between Smart City and SMEs, detailed empirical studies to examine the association between various variables of the two domains from the emerging counties' context are suggested. Also, a continued review study may be conducted to offer recommendations to reduce the barriers to implement the Smart City concept in the light of Society 5.0.

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Islamic Economic Assumptions in the Context of Islamic Tasawur: A Preliminary Discussion

Andaian-andaian Ekonomi Islam Menurut Konteks Tasawur Islam: Satu Kajian Awal

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Abstract. This paper aims to determine whether Islamic economics's assumptions are in line with the concept of Islamic Tasawur. These assumptions are divided into two categories: a scarcity of resources and unlimited human wants. The philosophical pillars of Islamic economics assumptions have been adapted from Western or conventional economics, then Islamized and transformed into Islamic philosophy. As a result, the assumption by mainstream Islamic economic scholars of the scarcity of resources and unlimited human desire cannot be universally accepted because its essence differs slightly from that of the Qur'an and the Hadith. These Islamic economic assumptions must be examined based on the Quran and the Hadith. As a result, it is critical to discuss Islamic economics's premises consistent with the Islamic Tasawur.

Keywords: Economic Assumptions, Mainstream, Scarcity of Resources, Unlimited Human Wants.

1 Introduction

The Islamic tasawur represents the primary form of Islam and explains the accurate and complete principles of Islam in its entirety so that the person who understands it is instilled with them (Hanapi, 2020; Noor Hisham & Burhan, 2019). The essential elements of the Islamic tasawur are Allah SWT as the Creator, human beings as creatures, and natural resources as creatures (Mohd Zulkifli, 2020). According to previous scholars, Islamic law is derived for justice, peace, and goodness for humanity's benefit. Also, Islamic law is divided into several categories, including worship and muamalat. Muamalat is divided into several sections, one of which is economical. According to previous scholars, Islamic law is derived for the sake of justice, peace, and goodness for the benefit of humanity (Ika Yunia & Abdul Kadir, 2018; Sarmiji, 2020).

Islamic economics is a study of human behavior concerning the diversity of desires and scarcity of resources with alternative uses to maximize falah, human well-being,

both in today's world and in the hereafter (Zubair Hasan, 2020). Eventually, the Islamic economic system began to evolve, and the rule of Khulafa'ar-Rasyidin continued (Addi Arrahman, 2020). Economic problems are not so prominent at this point, and Islamic economic theories are still undeveloped.

The diverse contributions of these Islamic scholars have also led to the development of Islamic economics and its use in dealing with society's economic problems. They analyze existing knowledge to learn more about the nature of the relationship between the economic aspects and Sharia law rules and the causes and effects of specific common economic issues. These scholars also develop a better understanding of knowledge or theory on economic and non-economic matters. Thus, the emergence of different views and assumptions to find answers to economic problems, but there are still theories and assumptions of Islamic economics that are still bound up with the Western economy, or conventional economics, and are slightly in conflict with Islamic principles and values. Moreover, current Islamic economics is said to have no theory of its own, instead of relying on borrowed mainstream worldviews, where Islamic ethics and morality are not incorporated into Islamic economic methods and models (Choudhury, 2018; Rafikov & Akhmetova, 2020). This study will therefore identify the Islamic economics that is in line with the Islamic tasawur.

2 Literature Reviews

2.1 The Concept of Economics According to Islamic Tasawur

Islamic and Western scholars often discuss the origins of things. Similarly, the meaning of the tasawur and 'worldview' in specific terms has yet to be discovered in the tradition of classical Islamic thought. Even so, this does not exclude the use of the tasawur as a systematic basis for the understanding of reality by classical Islamic scholars. However, it differs from the use of specific terms by Islamic scholars in the twentieth century to describe the meaning of this tasawur (Mohd Shukri Hanapi, 2014).

Table 1. Differences in the use of the Islamic term Tasawur

Islamic Scholars	Terms
Qutb (1965)	Al-tasawwur al-Islamiy
Al-Zayn (1982)	Al-mabda' al-Islamiy (Tends to understand it as a doctrine of rational belief that leads to the formation of an ideology.)
Al-Mawdudi (1985)	Nazariyyat al-Islam
Al-Faruqiy (1995)	Al-tasawwur al-tawhidiy (More prone to the concept of Allah SWT's power and oneness in shaping all aspects of human life.)
Al-Attas (1995)	Ruqyah al-Islam li al-wujud (More prone to philosophical and epistemological meaning.)

Based on Table 1, the difference in these Islamic scholars' terms is due to a lack of more appropriate and accurate definitions. Islamic scholars, therefore, use the terms "tasawur" and "Worldview" to describe a way of life that encompasses both worldly and eternal realities within its scope, as well as Islamic adjectives. With the combination of the word tasawur and Islamic values, then the existence of the Islamic tasawur means a full or accurate picture of Islam, which seeks to explain the basic principles of Islam properly and comprehensively, to become the basis for a life-view and to be instilled in a person (Mohd Zulkifli, 2020). It is, therefore, necessary to determine the correct term tasawur in order to play a role in the formation of civilization because it affects the beliefs, opinions, and actions of society.

Debates presented by Muhammad Syukri Salleh (2002, 2003a, 2003b) were discussed. He claims that the three (3) basic elements of the Islamic tasawur are Allah SWT as Creator, human beings as creatures, and natural resources as creatures. The first and second basic elements, namely the relationship between man (slave) and Allah (creator), are in a vertical (vertical) relationship (Mohd Zulkifli, 2020). The function of man as a caliph and servant is to surrender and obey Allah SWT's commands, which is explained by the human element as a creature. In contrast, the element of natural resources as a creature is when Allah SWT has created natural resources for use and human convenience. Natural resources are a tool that humans use to carry out their duties as servants and caliphs who obey Allah SWT (Mohd Shukri Hanapi, 2013). As a result, humans must make the most of these resources while avoiding going overboard.

The Qur'an, Hadith, Ijma (agreement between jurists), and Ijtihad (analogy and creative reinterpretation of legal issues) have been established as sources of reference in the Islamic era, which began in the 7th century (Aan Jaelani, 2018). Islamic economics is a term that refers to Islamic commercial law based on Islamic Sharia law (Al Harethi & Salem, 2019). The application of Islamic values to the Muslim community's economy is crucial, as it serves as a guide to success in this world and the next and gains the pleasure of Allah SWT. The difference between the conventional economic tasawur and the Islamic economic tasawur is that the conventional economic tasawur is based solely on conventional tasawur and epistemology. In contrast, the Islamic economic tasawur is based on Islamic tasawur and epistemology, including the Qur'an, Hadith, ijmak, and qiyas (Mohd Shukri Hanapi, 2014). As a result, the application of economics based on conventional economic philosophy will produce conventional economic concepts and theories. In contrast, the application of Islamic economic philosophy-based economics will produce Islamic economic concepts and theories.

As a result of this mixing, the Islamic economy is still linked to the conventional economy and thus not classified as a true Islamic economy. Moreover, mainstream Islamic economists who are influenced by Western values of neglect or Eurocentrism argue that conventional economic theories can be used as long as they are not incompatible with Islamic beliefs and sharia (Mohd Shukri Hanapi, 2014). Moreover, Islamic economics assumptions are said to be inconsistent with the genuine concept of Islam because philosophy has not been adopted from the outset. Therefore, this research is crucial to the resolution of the parallelism of Islamic economics theories

based on the Islamic tasawur. It is said that Islamic economics assumptions, such as unlimited human needs and scarcity of resources, have been derived from conventional economic theory. Since its nature is a premise, this means that the assumption can still be debated and disputed (Mohd Zaid & Mohammad Taqiuddin, 2018). The use by mainstream Islamic economists of two dominant thought streams is responsible for the assumptions of Islamic economics that are said to be linked to conventional economic theory (Muhammad Syukri Salleh, 2011). These are accommodative-modification and eclectic-methodological thought streams.

Muhammad Syukri Salleh (2011) agrees that Muhammad Abdul Mannan (1984) and Siddiqi (1989) ideas are the catalysts for this kind of thinking. He argues this reasoning because Muhammad Abdul Mannan (1984) adopted an eclectic approach by adopting conventional economic thinking, while Siddiqi (1989) used a method of integration or fusion between ancient neoclassical economics and fiqh (neo-classical based on fiqh). Moreover, the open nature of the two schools of thought is called accommodative-modification because it accepts neo-classical economics and allows them to be improved to make Islam, while eclectic-methodological thinking allows any thought or philosophy to be incorporated and incorporated into Islamic economics (Mohd Shukri Hanapi, 2014; Mohd Zulkifli, 2020). Moreover, Chapra (2001) and Abdel Rahman Yousri (2002) support both ideas by arguing that Islamic economics can use conventional economic theories as long as they do not contradict the logical structure of Islamic worldview, and argue that Islamic economics as a combination of sharia principles and conventional economics is unique (Mohd Shukri Hanapi, 2017). On the other hand, because of their acceptance of conventional economic philosophy, Mohd Shukri Hanapi (2014) and Muhammad Syukri Salleh (2011) are opposed to the method. This clearly shows that mainstream Islam is changing only in terms of its implementation, while the core of mainstream Islamic economics remains rooted in conventional economic theory (Mohd Haidzir, 2017; Mohd Shukri Hanapi, 2017). As explained in the previous study, this research is necessary to propose an appropriate theory of Islamic economics assumptions.

2.2 The Scarcity of Resources

One of the theories of assumptions in mainstream economics is the scarcity of resources, which is closely linked to the assumption of unlimited human desires. Scarcity exists in many forms, including money, products, and time (Cannon, Goldsmith, & Roux, 2019). Based on the Population Reference Bureau and Kennedy (2001), resource scarcity can be caused by three factors: demand, supply, and structure. First, resource scarcity occurs when there is an increase in demand for certain goods due to the rise in population or increased consumption while supply remains constant. Second, supply-induced scarcity resources occur when raw materials for the production of finished goods are not available due to environmental or political factors. Third, resource scarcity occurs when a segment of the population is limited to only a few items due to conflict or oppression (Rafikov & Akhmetova, 2018).

Moreover, the scarcity of natural resources gives meaning to the concept of efficiency in the sense of maximizing profits in an extremist way (Zubair Hasan, 2020).

Besides, Islam does not completely reject the assumption that resources are scarce because scarcity is a reality in life (Mohd Zaid & Mohammad Taqiuddin, 2018). Furthermore, there is also stated in Qur'an that every human being has guaranteed their future sustenance (Zulfan, 2020). The statement by Zulfan (2020) is also supported by Wahbalbari, Zakaria Bahari, and Norzarina (2015). They have stated that natural resources are vast and unlimited. Access to natural resources is determined by their level of knowledge that grows as they seek and attempt to access them and develops as they learn how to use them, as well as their location, extraction methods, and cost-effectiveness, all of which are determined by continuous learning, research, and action (Zubair Hasan, 2020). Allah SWT has also set the sustenance rate for humans at a certain quality as long as they try to find it. Therefore, there can be no doubt as to the distribution and acquisition of natural resources because they are the provisions of Allah SWT (Mohd Zaid & Mohammad Taqiuddin, 2018).

However, this does not mean that humans can use it indefinitely by failing to follow it properly. The debate on limited natural resources by mainstream economics scholars is synonymous with the assumption that unlimited humans will further strengthen their arguments (Mohd Zulkifli, 2020).

2.3 Unlimited Human Wants

Previous studies on the assumption of unlimited human wants have not been discussed in depth by previous Islamic economic scholars, most of them focusing solely on the assumption of the scarcity of resources. Human wants or desires may be defined as inherent desires and maybe temporarily fulfilled either on their own or in more complex combinations through the use of appropriate goods in appropriate quantities, and desires to satisfy desires that are driven by other activities (Mohd Zulkifli, Hanudin Amin, Dzulkifli Mukhtar, Shah Iskandar, & Noormariana, 2020). In addition, Yan and Spangenberg (2018) argue that wants can be unlimited, changeable, grow along with income, social position, and advertising stimulus, while needs are being continuously analyzed as anthropogenic and essential. Komala (2019) explains the difference between needs and wants from al-Ghazali's point of view: needs are all basic human needs for life, while will or desire is a human will come in every matter.

It is clear from the arguments of Mohd Zulkifli et al. (2020), Komala (2019) and Yan and Spangenberg (2018) that human will is something continuous and will not end because it is instilled or has become part of a human being. It can also be attributed to the human attitude of never being satisfied with the desire for something (Sloman, Garratt, & Guest, 2018) and the onset of this unlimited human wants. The basis of unlimited human wants to be rooted in the will of human lust alone. Human wants to follow desire is a will that is difficult to control because it seems ungrateful to what it has and always feels dissatisfied with. In Islam itself, the importance of prioritizing needs over desires to take care of human maslaha (goodness), such as following the maqasid sharia, has been emphasized and can at the same time help control lust. The three (3) categories of maslaha, which are stressed in maqasid sharia, are daruriyyat (basic needs), hajiyyat (complementary needs), tahsiniyyat (luxury). The philosophy of unlimited human will be slightly contradictory to the Islamic ta-

sawur because a good Muslim will keep within the limits of his relationship with Allah the SWT will always try to control his will and lust while at the same time fulfilling his wishes. Therefore, this study is essential for identifying the assumption of unlimited human desires that are compatible with Islamic tasawur economics.

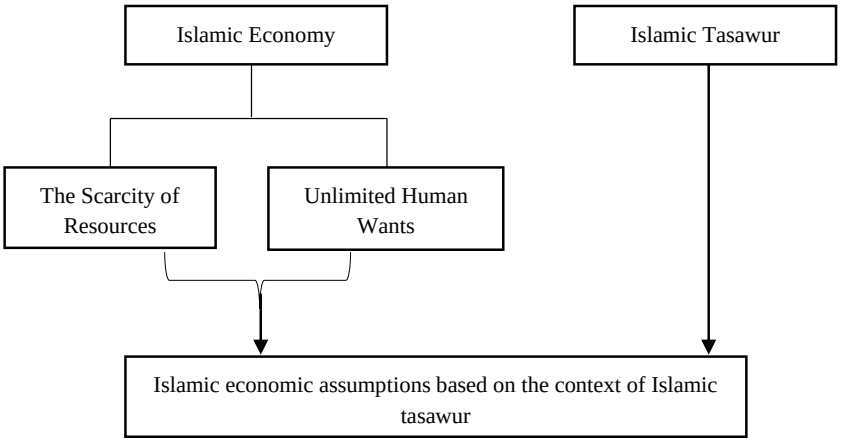

Fig. 1. Conceptual Framework

The conceptual framework of the study is shown in Figure 1. This study identifies the themes of Islamic economics that are the scarcity of resources and unlimited human needs. These assumptions are said to be inconsistent with the Islamic tasawur concept because the philosophy has been adapted from conventional economics. Research on assumptions, therefore, needs to be further studied. A more comprehensive study of economic assumptions is required.

3 Conclusion

The philosophical origins of Islamic economics assumptions are said to have been taken from Western philosophy or conventional economics, which was then Islamized and transformed into Islamic philosophy. In conclusion, the belief that Islamic mainstream economic scholars have a scarcity of resources and unlimited human wants cannot be universally accepted, as it is a little contradictory in the Qur'an. It is important to study these Islamic economic assumptions based on the Qur'an and the Hadith. In addition, it is important to address the Islamic economic assumptions that are consistent with the Islamic tasawur in this research.

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Synchronous Hybrid Classroom in Continuing Education – Tackling Challenges of Exchange and Networking

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Abstract. Digitalization is changing work content, jobs, and processes, making lifelong learning and investment in further education increasingly important. At the same time, it opens new opportunities for providers of continuing education programs by digitalizing teaching/learning settings. In a synchronous hybrid classroom, a video conferencing system enables simultaneous on-site and remote participation. Thus, this format offers potential for continuing education through the freedom to choose from where to participate in the classroom. Continuing education participants are often very busy at work and/or with care obligations and could therefore benefit from local flexibility through remote teaching. However, it is the exchange and networking opportunities that many participants expect from continuing education and which have so far usually been realized through face-to-face interaction. The implementation of synchronous hybrid teaching is associated with several challenges. Beside challenges of technological implementation and the demands on technical and didactical skills of the lecturers, there is a risk that the exchange and networking between participants will suffer. This paper develops key research questions regarding the future design of synchronous hybrid classrooms especially for the target group of continuous education participants. Different methods are presented, with which the necessary evidence could ideally be obtained.

Keywords: Continuing Education; New Learning Formats; Exchange and Networking Opportunities

1 Introduction

The modern (working) world is complex and characterized by continuous change, uncertainty, and ambiguity. Shaped by digitalization and automation, work content, work structures and activities as well as professions and occupational fields change [1, 2]. Existing knowledge becomes outdated, new competences are required and lifelong learning becomes necessary. To sustain employability, the development of skills is needed [e.g. 3]. Employers and employees therefore regularly invest time and money in continuing education and training activities and are interested in ensuring that participants benefit from them to the maximum.

The education sector and in particular the continuing education industry has been greatly impacted by the COVID-19 pandemic. Before the COVID-19 pandemic, providers of continuing education in Switzerland relied mainly on face-to-face teaching and very few pursued blended learning or online concepts. Due to the lockdown, educational institutions worldwide were immediately forced to stop face-to-face teaching, including universities in Switzerland. Thus, the pandemic brought a real digitalization push: According to the current continuing education study in Switzerland [4], 85% of the providers surveyed stated that they had adapted their continuing education offerings by digitizing the teaching/learning settings. However, the way in which continuing education was adapted varied widely, from online instruction using video conferencing software to a higher proportion of guided self-study. There is evidence that continuing education participants have different preferences regarding new teaching and learning formats. While some participants are positive about online instruction and increasingly accept virtual instruction, other participants prefer face-to-face instruction [4–6]. For many, face-to-face teaching is still the best way to ensure direct exchange among participants and to promote networking. On the other hand, online and blended learning formats open new possibilities to cooperate and network with even more participants and lecturers – also abroad and outside the organization. The synchronous hybrid setting offers the advantage that it considers the preferences of the different parties, since this form allows participants to choose whether to attend classes on-site or online.

For education in society 5.0, questions therefore arise as to how continuing education should be designed in the future to optimally combine digital possibilities and the different needs of continuing education participants for digital instruction as well as for exchange and networking. It seems fruitful to investigate synchronous hybrid settings in continuing education, because it offers potential to combine both aspects.

In the following, we first shed light on continuing education and the motives of participants in continuing education. Then we present the available evidence on synchronous hybrid teaching. Finally, we discuss whether synchronous hybrid teaching is a useful option for continuing education and outline the open questions that still need to be answered. We end with an outlook on how the research questions could be investigated.

2 Continuing Education

OECD, UNESCO and Eurostat distinguish between three forms of learning: formal education, non-formal education, and informal learning [7]. Continuing education is classified as non-formal education: “Non-formal education includes institutionalized, deliberate education planned by an education provider outside the formal education system. This can include, for example, courses, conferences, seminars, private lessons, or on-the-job training” [8]. At the macroeconomic level, continuing education contributes to the competitiveness of countries and economic development and has a positive effect on society. The private and the public sector benefit from people updating their skills with adequate continuing training programs [9]. Therefore, employer often encourage participation in continuing education and contribute to the costs. In the context of the

changing workplace, life-long learning helps employees to foster their adaptability [e.g. 10]. Under the umbrella term "continuing education" there are many different formats that differ in terms of objectives, duration, and design [11]. Continuing education usually aims to link knowledge with action. The focus is on applying what has been learned and interacting with other participants [12].

The continuing education market in Switzerland is competitive and according to estimates there are around 3,000 continuing education providers in Switzerland [13]. Other providers include small, medium, and large private providers organized on a private-commercial or private-nonprofit basis [4]. Before the COVID-19 pandemic, 90% of continuing education providers in Switzerland focused on face-to-face instruction [14]. About half of them relied on largely "technology-free" face-to-face instruction, while the other half focused on digitally supported face-to-face instruction. Fewer than 10% used blended learning and only 2% of providers offered online instruction. According to a current continuing education study [4], 85% of the providers surveyed stated that they had adapted their continuing education offerings by digitizing the teaching/learning settings. But the way in which continuing education was adapted varied widely, from online instruction using video conferencing software to a higher proportion of guided self-study. However, it seems clear that digitalization efforts in the continuing education industry will be sustained. Over 80% of the surveyed providers also plan to incorporate some or all the adapted digital offerings into their permanent programs [4].

2.1 Continuing Education Participants

For the individual, training courses offer the opportunity to maintain their personal employability or to pursue their self-development [9]. Over the last 10 years, participation in continuing education has increased in Europe and Switzerland is one of the countries with the highest rate of continuing education [15]. For example, 62.5% of the population in Switzerland between the ages of 15 and 75 attended a continuing education program in 2016 [8]. The highest participation rate is shown by persons aged 25 to 34 (76%). Among the older age groups, participation in continuing education decreases and is about 70% for the 35- to 44-year-olds and 68% for the 45- to 54-year-olds. This peak participation rate among the youngest age group is not necessarily observed across countries. In Germany, for example, the participation rates in 2018 were the same among 18- to 34-year-olds and 35- to 49-year-olds, at 57% each [16].

According to a survey by the BFS [8], participants most frequently attended continuing education courses for professional reasons, and only a small proportion attended further education courses purely for non-professional reasons. The main reasons for their participation were "stay up-to-date / maintain knowledge" (89%), "be able to do work better / increase career opportunities" (85%) and "personal interest in the subject" (80%). Slightly more than half of the continuing education activities were sought out because of organizational and technological change in the workplace (57%). Studies that examine reasons for non-participation in continuing education support the assumption that participants only take part if they expect a benefit for the future that is higher

than the costs caused by the continuing education [11]. The main reasons cited are a lack of expectation of benefit as well as time and financial restrictions [17].

There are increasing indications that access to continuing education will have to be more individualized and differentiated in the future to be well received by the target group. Jansen et al. [6] evaluated the conversion to distance learning in the continuing education programs of a Swiss University of Applied Studies. More than 400 current participants took part in addition to program managers and lecturers. The results showed that this target group sees the benefits of online instruction and just over half would like to be able to participate more "remotely" in the future. Therefore, the question arises how continuing education should be designed in the future to optimally combine digital possibilities and the different needs of continuing education participants for digital instruction as well as for exchange and networking. It seems fruitful to investigate synchronous hybrid settings in continuing education, as this form allows participants to choose whether to attend classes on-site or online.

3 Synchronous Hybrid Classroom

In addition to face-to-face interaction and purely virtual interaction, there is a learning environment that combines these two formats. In a synchronous hybrid classroom, one part of the class attends on site and the other part participates virtually at the same time while connected to the same platform. Technical settings such as a platform with a video conferencing system, possibly combined with a chatroom and a synchronous brainstorming tool enables simultaneous on-site and remote participation.

In the literature this teaching format can be found under the designation "blended synchronous" [18] or "synchronous hybrid" [19]. "*The concept of the hybrid virtual classroom comprises one group of learners who participates in the course on campus, and simultaneously other individual learners participate in the course remotely from a location of their own choice by connecting to the same platform*" [20]. Synchronous hybrid teaching must be distinguished from distance learning (purely virtual teaching, synchronous or asynchronous) and blended learning (mix of teaching units in presence and in distance learning, synchronous or asynchronous) [21]. This teaching format is most prevalent internationally in higher education, where providers are faced with increasing student enrollments and simultaneously decreasing budgets [22]. Hybrid synchronous teaching is seen as an alternative to asynchronous online teaching because it offers students the opportunity to interact more and be less isolated [23].

3.1 Benefits for Participants and the Organization

In the context of our networked society where we are interconnected and pursue very different life plans, it is important that education is not dependent on location [24]. The synchronous hybrid learning environment meets the student's need to be able to learn with a high degree of flexibility: they are free to choose from where they take part in the lessons and can thus also save travel time. This choice allows students at all stages of their lives to participate in learning opportunities and the organization can appeal to

a broader base of students [20]. In this respect, a synchronous hybrid classroom enables a more equitable access to knowledge and a more inclusive education [25]. Synchronous hybrid teaching opens possibilities to cooperate even more with universities and lecturers abroad and outside the organization (e.g. a group joins in from abroad). In this way, students benefit from more perspectives, ideas and expertise [26]. This given flexibility also ensures that continuity of instruction can be provided and additionally promotes student retention [24].

3.2 Challenges for Lecturers and Participants

Besides the numerous advantages, the implementation of synchronous hybrid teaching involves several challenges. In addition to technical challenges [e.g. 25], lecturers need technical and didactic skills to handle the system and to design lessons in such a way that the two groups ("on-site" and "remote") have a similar learning experience [20, 27]. This is because lecturers need to engage with two groups at the same time and coordinate and facilitate the exchange between remote and on-site participants [24].

For the "remote" participants who join virtually, there is a risk that they slip into a purely observational role, as they have insufficient understanding of the voices in the room and therefore (can) participate little in the discussion. In turn, it can be awkward for "on-site" participants and interrupt their flow of conversation if they must watch the camera and microphone to say something [25, 28]. Because non-verbal cues are very limited in this setting, it is difficult for participants to know when to speak [29]. In addition, there is evidence that student engagement in a purely online setting is highly variable [6, 24]. Another study showed that remote students reported significantly lower levels of relatedness than their on-campus counterparts in synchronous hybrid settings [23]. These two challenges are important in the context of the self-determination theory [30] and the social presence theory [31], which state that interaction and networking among students is central to their learning success. When the need for social interaction is not fulfilled, students become disengaged, leading to declines in motivation and learning success [32].

4 Format for the Future? Synchronous Hybrid Classroom in Continuing Education

As mentioned in the previous section, synchronous hybrid teaching has been used mainly in higher education and, to our knowledge, there are no studies in the context of continuing education. Following a recent literature review, Raes et al. [19] conclude that only a few studies are available on this variant of hybrid teaching. The 47 studies they included point to the advantage of local flexibility but also highlight the associated technical and didactic difficulties [25, 28]. Research and practice on synchronous hybrid teaching are still in its infancy. Since so far mainly exploratory and qualitative studies are available that have primarily focused on organizational implementation and technological design. Good microphone/streaming technology is a prerequisite for synchronous hybrid teaching, but even the best system does not ensure that participants

will benefit from teaching in this setting. There is still the question of how to promote exchange and networking in this setting and how to design synchronous hybrid instruction so that it leads to good quality learning experiences. After all, it is precisely the exchange and networking opportunities that continuing education participants expect from a continuing education program. Research is needed that examines the different scenarios and their consequences on students' learning experiences. Furthermore, existing studies are concerned with the context of training of lecturers and do not shed light on the requirements of the target group of continuing education participants. We can use these unresolved issues to formulate a more specific research agenda for future studies examining the potential of synchronous hybrid learning in continuing education.

4.1 Intention No. 1: Focus on the Needs of the Participants in the Synchronous Hybrid Classroom

The needs and expectations of participants in continuing education have changed. They increasingly want to decide for themselves for which parts of their training they want to take part on-site face-to-face and for which parts they want to take part virtually [4]. This choice appears to be a particular advantage for the target groups of continuing education programs: These individuals often consciously opt for continuing education with face-to-face instruction rather than pure distance learning, as they are interested in more than simply acquiring knowledge and want to exchange ideas and network with others [11, 33, 34]. Face-to-face classes offer ideal conditions for this, as participants can exchange ideas informally during the common coffee and lunch breaks, in addition to the planned exchange in small groups or in plenary sessions. This exchange with other participants is central to informal learning [35]. At the same time, however, this target group is often very busy at work and/or with care obligations, and classroom instruction with compulsory attendance on site presents them with major organizational challenges. By offering flexible learning paths, continuous education providers can respond to the changing needs of their customers. In the context of the increasing relevance of lifelong learning, synchronous hybrid teaching also lends itself to continuous education [19, 20]. To find out what the participants' real needs are and to be able to assess the potential of this format for continuing education, research is needed on how (potential) participants in continuing education evaluate this format and how exchange and networking between participants can best be promoted. The question that comes up is: *How do (potential) participants in continuing education rate different scenarios of synchronous hybrid teaching depending on the concrete implementation and compared to teaching in a purely face-to-face or online format?*

4.2 Intention No. 2: Focus on Creating Opportunities for Networking and Exchange in the Synchronous Hybrid Classroom

Previously, several challenges of the participants in synchronous hybrid settings have been outlined (interruption in the flow of conversation, inactive remote participants, limited non-verbal cues, different levels of relatedness). These findings indicate that the learning experience might be different for on-site and remote participants. In

addition, it became clear that interaction and networking among participants of continuing education is crucial – for their learning success, but also because these two dimensions are expected by the participants and are therefore both expectation and motivation for participation in continuing education.

A way to address the challenge of interruption in the flow of conversation and inactive remote participants is to promote active learning through group work [18]. In the synchronous hybrid setting, break out rooms of virtual video conferencing tools can be used for that matter. In addition, you could look at the influence of mixed group work, e.g. if one deliberately mixes remote and on-site participants. Existing research [23] gives an indication that students who participate remotely in synchronous hybrid classes feel less related than students who participate on-site. To address this, you could look at the influence it has when it is not always the same people in one group, e.g. when participants can choose each time whether they participate remotely or on-site. Finally, it became clear that it is a great challenge for lecturers to design and moderate lessons in a synchronous hybrid setting because of the two groups. We assume that the group size therefore has an influence on the success of the lessons and thus also on the exchange possibilities. A relevant question that arises regarding sharing and networking opportunities in the synchronous hybrid setting is: *What influence does the design of group work have on the individual evaluation of exchange and networking opportunities? What impact do different aspects of group work have on individual perception of sharing and networking opportunities?* Furthermore, it would be important to find out what impact it has on the satisfaction with exchange and networking opportunities if the participants can freely and/or spontaneously decide whether they participate on-site or remotely for each day of instruction. Is it important for participants' rating of the exchange opportunities that there is a fixed proportion of the on-site group? (e.g. 1/3 of the class should always be on-site). Does this have an influence on the motivation of the participants? In addition, it seems fruitful to find out more about the impact of the group size in general on these topics.

We outlined two relevant focal points that should be considered in future studies on the potential of synchronous hybrid classroom for the target group of continuing education participants. In the following part we explore for this purpose new directions of research.

5 Exploring new Directions for Research

Various approaches appear to be useful to investigate the research questions identified. In the following we address the methods formative and summative evaluation, field experiment and the factorial survey.

5.1 Formative and Summative Evaluation

To investigate the learning experiences of continuing education participants in synchronous hybrid classrooms, continuing education programs that already implement synchronous hybrid teaching could be examined. In a formative and summative evaluation [36, 37], participants and instructors are asked about different criteria. Thus,

participants would receive a questionnaire after each session of the program or at the end of the program to assess their learning experience and rate the possibilities for exchange with other participants and the lecturer, the possibilities for networking and other variables such as distraction, goal achievement and satisfaction. Information on the specific design of the setting is obtained from the instructor. Program evaluations are carried out regularly by many training providers to ensure quality [38] and should therefore be able to be supplemented by additional questions on the experience of the synchronous hybrid setting.

Through a survey after the sessions, information is obtained about how participants experienced the synchronous hybrid setting. Their evaluation depends on the specific implementation in the program, e.g. what technology was used, how was group work organized, what is the instructor's experience with this teaching format. When comparing different courses that all use synchronous hybrid classrooms, it is difficult to identify the factors that have the greatest impact on participants' learning experience and perceived exchange and networking opportunities. For example, it is difficult to determine whether choice (remote or on-site) or size of the respective groups are determining factors.

5.2 Field Experiment

A field experiment in a real-world setting offers the possibility to systematically vary different factors [39]. They are characterized by a high degree of realism of the situation and thus a high external validity. In return, one must accept limitations regarding internal validity: confounding variables cannot be controlled or only with difficulty. A field example could be used to find out what minimum group size is necessary on-site to meet the needs of the participants. Furthermore, one could vary whether participants in a multi-day program can decide spontaneously whether they want to participate on-site or remotely, or whether they must decide at the beginning of the entire program. Thus, instructors of continuing education programs could all receive the same training on how best to implement the synchronous hybrid setting (for example technical aspects, design of group work) to control for disturbance variables. Selected variables would then be manipulated. However, randomized assignment of participants to on-site and remote groups would not be feasible, since the training participants are paying customers who therefore cannot be forced into a group.

5.3 Video Vignettes in a Factorial Survey

Since many continuing education participants have not yet had the opportunity to gain their own experience with a synchronous hybrid classroom, a factorial survey with video material can be a suitable way to find out how they evaluate different scenarios of this format. This research method combines the advantages of the classical experiment with the advantages of a questionnaire survey [40]. In a standardized survey, the influence of characteristics of e.g. situations on people's perceptions and judgments is elicited [41, 42]. Short descriptions of a fictitious situation (vignettes) are presented to the respondents that differ systematically in the characteristics to be investigated.

These descriptions are not presented as descriptions, but as short videos, each showing a concrete teaching situation. Regarding the synchronous hybrid classroom, this means that the setting presented is systematically varied. Thus, the participants of the study receive video examples in which it is illustrated as if they participate "remotely" or "on-site" in class. Furthermore, in these videos it can be varied, for example, how the exchange between the participants and the lecturer works and how large the group of remote or on-site students is. Respondents can be randomly assigned to the "on-site" or "remote" situation and a comparison with pure face-to-face and online instruction is possible. Thus, data can be obtained based on which evidence-based recommendations can be made without having to burden paying continuing education clients with an experimental setting.

All three approaches can be ideally complemented to explore the research questions related to synchronous hybrid settings. A factorial survey could be used to determine the needs and fears of continuous education customers regarding the implementation of this setting. In a quasi-experimental field experiment, the variables that proved to be crucial could then be manipulated and their effect on e.g. participant satisfaction with the exchange possibilities could be measured. Finally, the implementation in continuing education programs should be accompanied by a formative and summative evaluation to gather further insights regarding the teaching format.

6 Conclusion

Increasing digitalization has created new opportunities in the continuous education market that interact with the needs of the heterogenous group of potential continuous education customers. The synchronous hybrid format, for example, offers participants freedom of choice with the ability to attend courses either on-site or remotely. So far, however, little is known about how this setting is ideally implemented and which technological and didactic skills the lecturers need so that the goals of continuing education participants regarding exchange and networking can be achieved. For providers to take advantage of this potential, evidence is needed regarding the specific needs of participants in terms of their learning experience and in particular their exchange and networking opportunities. This should be gathered through factorial surveys, field experiments and formative and summative evaluations. With this evidence, concrete design recommendations for synchronous hybrid settings can be derived. These design recommendations are also valuable for companies for their implementation of meetings and internal training courses.

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Towards Context-Oriented Process Modelling in the Circular Economy

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Abstract. In the linear economy model, Lean Management and Process Excellence were initially developed in the automotive industry but they were slowly adapted by service industries, such as banks or insurance companies to optimize their own Business Processes (BP). When optimizing BP, models are created and BPMN (Business Process Modelling Notation) serves as a standard notation to design and optimize BP with the help of well-known KPIs (Key Performance Indicators). However, the recent trend of considering the circular economy in an organization's optimization initiatives has resulted in increasing pressure to put additional focus on environmental-friendly production processes.

Consequently, business process models today should not only be optimized according to the principles of process excellence but also put more emphasis on design as a part of circular economy (CE) to gain environmental excellence. Thus, BPMN models need to become more context aware. The objective of this exploratory paper proposes varying ways to incorporate well-known aspects of CE into the methods, models and tools of Business Process Management in order to move towards a Context-Oriented Process Modelling in the Circular Economy. The aim is to contribute to the discussion on how additional measures from environmental, economic and financial incentives could generate an impact on how products and services should be designed in a human-centered and environmentally friendly Society 5.0.

Keywords: Circular Economy, Business Processes, BPMN, Recycling, Refurbishing, Sustainability, Financial Incentives, Key Drivers

1 Introduction

During the Third Industrial Revolution, the automation of processes in the manufacturing industries was heavily influenced by the Japanese car manufacturers. Additionally, the breakthrough of Business Process Management (BPM) was initiated by Ford Motor Company's observations that Mazda's purchasing process was about three times more efficient than its own process. In the Fourth Industrial Revolution, the

focus is on further process improvements with the help of Internet of Things (IoT), and the idea to generate more insights for improvement by creating a Data-Information-Knowledge cycle. In contrast to Industry 4.0, Society 5.0 shifts its focus on the impact of technology on the public and the aim and need to create a better society (Society, 2020).

However, a human-centered society will not happen without taking Sustainable Development Goals (SDG) into account, which the U.N. agreed to in 2015. In the United Nations Environment Programme 2019.3 (UNEP, 2019), sustainable consumption, production and resource efficiency are mentioned as key elements for achieving the 2030 Agenda. Besides enabling policies on the environment and a sustainable lifestyle, sustainability in businesses is one of the key focus areas of the Resource Efficiency sub-programme, which is divided in five different indicators. Amongst these, "increasing the number of public and private finance stakeholders that adopt sustainable finance principles, processes and frameworks" and "increase in the number of companies that report sustainable management practices they have adopted" are mentioned. But can we actually measure the facts and figures in order to show progress?

Given the fact that the Fourth Industrial Revolution preserves the basic principles and best practices of the Third Revolution in terms of BPM, and also adds the insights from IoT to build an additional context of data and knowledge to the production process, SDG could serve as additional context for Society 5.0 by adding aspects of the circular economy to BPM. The importance of context-orientation of BPM is well recognized and numerous methods to incorporate the different process dimensions (e.g. value contribution, knowledge intensity, creativity etc.), organization dimensions (e.g. industry, size, culture, resources etc.) as well as environmental dimensions (e.g. competitiveness, uncertainty) into account (vom Brocke et al., 2021). However, the processes management of the linear economy models should be turned into circular process thinking and the ideas of lean management of processes should be enriched with clean management objectives including, once again, a move towards a Context-Oriented Process Modelling in the Circular Economy.

2 What is the Circular Economy?

2.1 Background

The current linear economy where resources are extracted, shaped into products, sold to consumers, and then simply wasted at the end of their life cycle is undisputedly behind the record levels of pollution such as discarded plastics, microplastics, e-waste, apparel, etc. in the environment. This same linear economy is also responsible for the pressure on renewable energy flows that are reaching the breaking point. Additionally, the linear economy model has caused a tripling of the global extraction of materials between 1970 to 2017 (Oberle et al., 2019).

Consequently, this is undeniably posing a major global risk, not only because of ever increasing resource scarcity, but also because 90% of our biodiversity loss and water

stress has been directly linked to material extraction. Hence, a new model of production is clearly required to help halt environmental degradation and excessive material loss caused by the linear economy's *"take-make-consume-waste"* processes. The goal of circular economy principles of production is to mimic nature where everything is available in abundance and nothing is wasted. In the future, there will be two material streams: metals that are kept in circulation as long as possible; and biomaterials that can biodegrade and become a resource for new products. The circular economy will also rely on renewable energy and additionally be free of toxins (Ellen MacArthur Foundation, 2013).

The outline below, designed by the Ellen MacArthur Foundation, illustrates this flow of two different materials, namely Renewables and Finite materials:

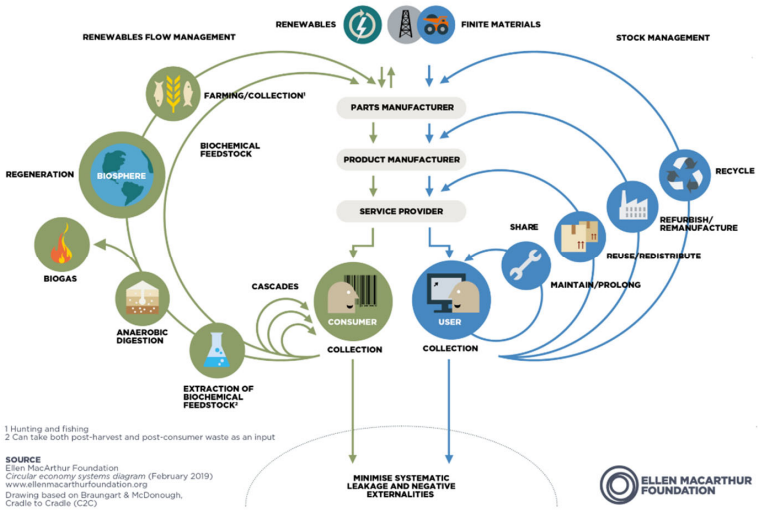

Fig. 1. Outline of the Circular Economy *Source: Ellen MacArthur Foundation*

Aligned with this Outline of the Circular Economy are three principles:

- Principle 1: Preserve and enhance natural capital by controlling finite stocks and balancing renewable resource flows.
- Principle 2: Optimize resource yields by circulating products, components, and materials, at the highest utility at all times, in both technical and biological cycles.
- Principle 3: Foster system effectiveness by revealing and designing out negative externalities.

At the core of Principle 2, is the design for remanufacturing, refurbishing, and recycling in order to keep materials in circulation. What is meant by "to design for

remanufacturing, refurbishing and recycling" for companies? Simply put, a new modelling is required to design out waste. And waste analysis needs to be incorporated into our current business models, as well as, our current business process models for organizations.

2.2 Design Out Waste

The first person to introduce the Cradle-to-Cradle concept was Walter Stahel, who is considered by many as the "father" of the circular economy (Stahel, 2010). This term gained worldwide traction when William McDonough and Michael Braungart published a book with the same title, Cradle to Cradle: Remaking the Way We Make Things. Their fundamental premise is that – like in nature – waste is reused and in effect ultimately becomes nutrients for subsequent growth (Baumgart & McDonough, 2009).

As the world is increasingly still being covered in waste, to reach this level of alignment with nature, a totally different approach to products and services is clearly required. The primary responsibility lies in the design phase because once a product specification is decided, it enters the production phase and then afterwards only minor changes become possible (Nasr, 2016). Decisions made at the design phase influences 75% of the products economic cost and 75% of its social and environmental impacts.

Not surprisingly then, design has gained an important role in rethinking the production process, but this new requirement must consider not only designing products that are going to have another life cycle but to also design out waste completely. This requires a momentous shift in thinking about immediate product form and functionality to the product's ultimate long-term value to the customer. In the circular economy, the "why" behind purchasing a product will have to play a key role in design. In a human-centered society, this will mean that products ought to be designed for consumer attachment and trust or emotional durability.

In the following chapter, we will elaborate about how this new development influences the production process and more specifically why a move towards a Context-Oriented Process Modelling that considers the CE will become increasingly essential.

3 Business Models and Business Process Modelling for Circular Economies

Reshaping industry and revamping existing organizations will also necessarily result in the need to adjust the models that we use to describe them. The purpose of models can either be descriptive or prescriptive. Descriptive models can be used to visualize an existing artefact and prescriptive models can be used as design blueprints to describe this object to be built. Models can also be used at different abstraction levels. Current models of the circular economy, such as those from the EMF (Ellen MacArthur Foundation, 2013), are mostly of a prescriptive character and are described from a very high abstraction level. In effect, they are graphical semantic representations rather than models with a defined syntax of different drawing elements. Yet, some models do describe the CE from the system dynamics approach, which can prescribe the effects

of remanufacturing, analyze sensitivities of the different input parameters or plot essential system parameters such as transportation cost, energy consumption, or any other KPI of interest over time, such as the model of a Reverse Supply Chain by A. Brissaud (Alamerew & Brissaud, 2020).

Nevertheless, standardized business process models or business process landscapes, which are often used to describe the process architectures of circular economies are rarely be found in the BPM literature. Process redesigns and process improvements related to aspects of lean thinking during the Third Industrial Revolution are mainly focused on the qualitative and quantitative analysis of value adding, business value adding and non-value adding activities (VA, BVA, NVA) within the business processes and targeted towards the elimination of waste, such as the well-known seven Mudas (transportation, inventory, motion, waiting, over processing, overproduction, and defects).

With respect to a data-driven and event-based approach of Industry 4.0, event-driven information system architectures such as the Line Information Systems Architecture (LISA) have been proposed (Theorin et al., 2017) and describe the processes from a perspective of functional hierarchies of processes from a Level 5 (company management) down to Level 0 (the actual production process). However, as yet, no comparative approaches exist which incorporate aspects of CE to the BP modelling.

3.1 Current Business Models and Process Landscapes

When addressing business process management within organizations, process landscapes serve as the first entry to grasp the Level 5 or Level 4 process architecture. Most BPM tools support to draw abstract models with these typical process shapes, while some of the tools even provide the possibility to draw organizational charts and link them with control objectives or performance indicators.

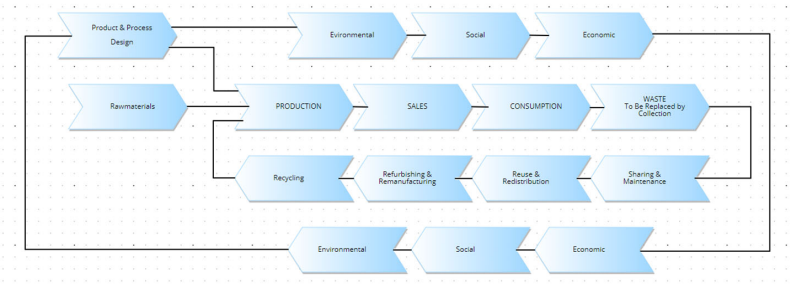

Fig. 2. Process Landscape for Circular Economies

Most products today are still designed for a single use purpose and become, at the end of their life cycle, a waste product where the process landscape only contains the process chains of raw materials – PRODUCTION – SALES – CONSUMPTION - WASTE, as depicted in the second row of the process landscape in Figure 2. While the product and process elements of the production have been improved and optimized, the

goal has been on resource efficiency as raw resources are a major cost factor in the production. And the process of Collection, which is the entry point of the CE, is not taken into account.

After a company has produced a product, the Sales Department's primary effort is to convince customers to purchase as many as possible of these goods. The next goal related to the products' consumption – from the producer's standpoint – is to ensure that the products last a very limited period of time in order to bring the consumer back to the Sales Department. The role of the optimization has been to create a perfect process for a product but, in practice, this process should not be too perfect! If too perfect, the product will not be wasted and would not open the door to a new purchases as increased sales remains a key element of the old, linear process model. This approach led to planned obsolescence. "*Most products are designed for a single life cycle and then discarded.*" (Nasr, 2016). In the new circular economy model, design carries with it far more responsibility. Indeed, it is at the very center of decision making because design will determine the length of the lifecycle and the path of the product at the end of its life. In the linear model, in effect, waste was never even considered.

The circular economy is also shifting the focus from the quantity of products sold to the core value of the product itself. For example, the rise of the sharing economy where a product is fundamentally a service that offers customers the functionality and value of the product, but these considerations need not be aligned with the actual ownership of the product. A new generation of the consumers is primarily interested in the benefit of the product but without ownership. At the same time, this development is creating an additional incentive for producers to manufacture durable products because companies can also be paid for the service and usage of the product and, consequently, are no longer under urgent pressure to replace it with a new product. This same premise obviously is valid for the Three Rs (Reuse, Repair and Recycle).

As the following graphs illustrate, when design is at the center of the production process, the former equilibrium of the linear economy shifts.

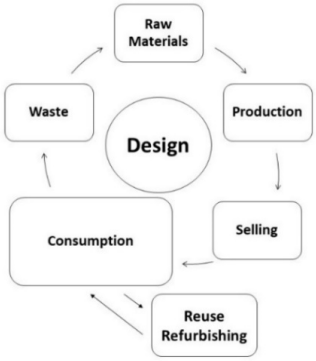

Fig. 3. The Circular Flow for Reuse and Repair with the Design at its Core

In the Reuse element above, the increased lifecycle of the product requires higher quality criteria and standards as products are resold and enter their second (or even third) lifecycle. Due to reusing products, there is significant less need for new raw materials which – in the end – leads obviously to less waste.

The same Refurbishing element, "Right to Repair" is one of the corner pieces of the new European Green Deal (European Commission, 2019). The Repair concept adds similar challenges to the production and the quality expectations as with the Reuse model. The core difference is that the product remains with the same ownership, but the lifecycle of the product gets extended. The third option is the Recycling solution. Again, when design is at the center of the production process, the decision as to what happens with the product at the end of the lifecycle is actually decided during the design phase. This process will ultimately eliminate landfills, incinerators, and the illegal trade of waste.

However, this model requires a few additional steps before the products can be returned fully to be used as raw materials once again. These include the separation process conducted by consumers, professional collection options and waste separation that is then prepared for recycling.

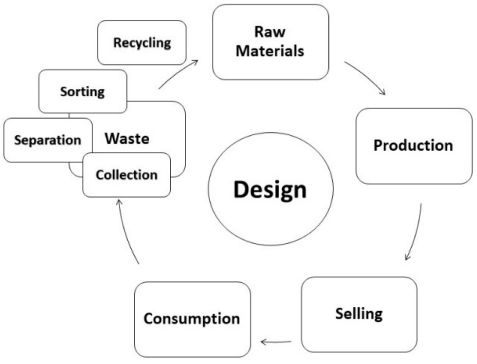

Fig. 4. The Circular Flow for Recycling

Considering all of the required changes to the production process, how can a company adjust its processes to meet these emerging market demands?

3.2 Improving Existing Process Models

The International Organization for Standards provides and develops standardized frameworks and principles which help to implement SDGs, where the ISO 14000 family is dedicated to support organizations to minimize the negative effects of their

operational processes on the environment. The well-known Plan-Do-Check-Act (PDCA) cycle, mentioned in ISO14001, points out the important aspects of a continuous process improvement. However, not all of the processes that are implemented in organizations will have an impact on the global SDGs and also on the traditional assessments of the process portfolio where the processes can be listed on a two-dimensional pick-chart in order to determine, which of the processes should be focused on first to generate the highest possible return on investment.

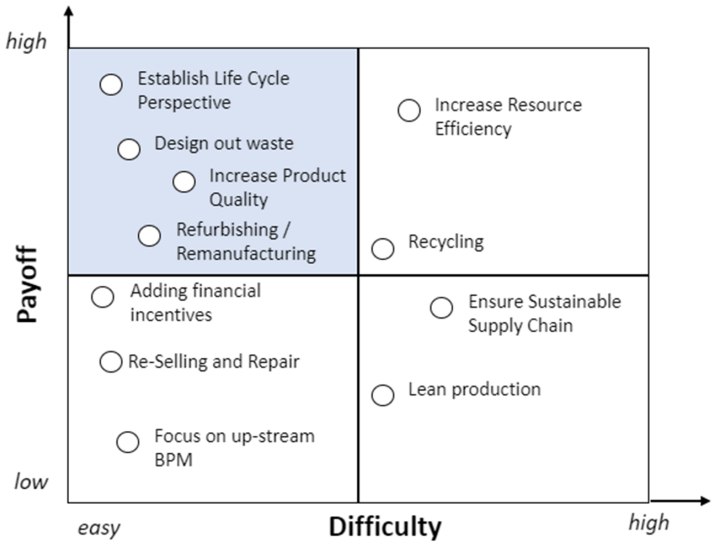

Fig. 5. Pick-charts to Prioritize the Processes Candidates for CE Improvements

Figure 5 shows some examples of process candidates. The processes on the upper left corner should be picked first, since they are easier to implement and the impact, which could be generated in terms improving the KPIs of CE, is at the highest. The processes could be taken from the different abstraction levels. The lower the level, the more detailed the process needs to be described.

Once the candidates for improvements are identified, the processes are analyzed and modelled at the appropriate level of detail with the help of the standardized Business Process Modelling Notation (BPMN 2.0). In many cases, they might still be on a high abstraction level such as those from the process landscape in Figure 2. However, when talking about manufacturing processes in a circular economy, circular visualizations such as those in Figure 3 and Figure 4 should be taken into account. With current tools, traditional linear landscapes can easily be modelled in the typical traditional up-stream and down-stream thinking models. Workarounds to build circular models such as illustrated in Figure 2 are possible, but not as yet satisfactory.

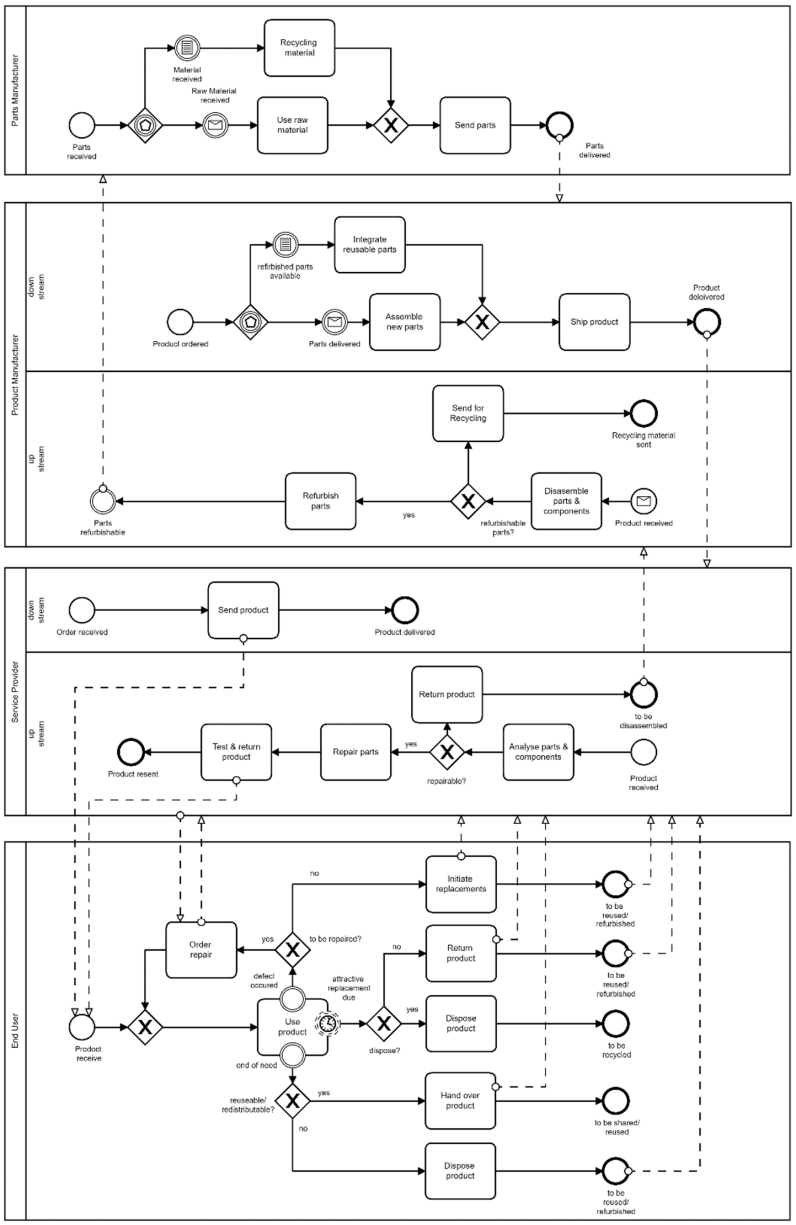

Fig. 6. Detailed BPMN models including up-stream processes from CE

Also, when diving deeper on the BPMN level to describe operational processes, there are certain difficulties to mimic circular processes. Given the scenario of any typical production process, which should be redesigned according to the principles of collecting, reusing and refurbishing or recycled raw materials, the material flow cannot be well be expressed with the current layout possibilities, as seen in Figure 6.

Such process models could be used to analyze the activities in place and are capable to point out some aspects for re-design. However, the possibilities of this low-level process modelling currently also has some shortcomings with respect to the expressiveness of the model, as previously noted in terms of a circular layout of high-level process landscapes. At lower levels, BPMN 2.0 currently only provides two types of flow: the dashed arrow represents information flow; and the arrow with the solid line represents sequence flows. Yet, there is the possibility to add information objects as input or output of activities, as there is currently no syntax for the representation of material flow!

Nonetheless, new process models should incorporate the idea from turning the "take-make-consume-waste" pattern of many of our current goods into a service-based scenario. In the linear economy era, the end-users must decide whether a broken product should be repaired or thrown away. Due to high service costs, they will likely throw the product away or perhaps return it to the store they bought it. In the circular model, this decision should be assigned to the service provider, who in turn can further delegate decisions to the product manufacturer. So, ultimately, the likelihood of refurbishing parts will be more likely increased. Unfortunately, this development is often associated with increased initial costs for the manufacturer. So, why would a company change? Which incentives could motivate the manufacturer to incorporate this new circular model?

4 Driving Forces and Factors

A main driving force for any change within the company is considering consumer preferences, and clearly these days there is evidence that indicates consumers are ready and willing to contribute to a more sustainable world. Additionally, governments are adjusting their rules and regulations to meet these sustainability demands. It is also increasingly beneficial for companies to go green as it has been shown that enterprises that comply with environmental standards have higher profits (Yao & Yang, 2012). Yet, despite this evidence and the enforcing framework, how can companies finance their transition?

The major factor behind all business development is, without any doubt, the access to capital. However, the recent transition to the circular economy has caught financial institutions flatfooted and unprepared. One of the reasons for this is that financial institutions are under pressure to comply with the ESG criteria which have an environmental aspect within but do not as yet require a transition to the circular economy. Hence, the circular economy is still largely underrepresented within the financial industry.

As Yunyan & Biao (2014) rightfully argue, to accomplish resource reduction, companies must depend on large-scale production to reach economies of scale. Committing to only a small circular change does not help the company, nor the environment, and a complete transition is associated with high investments. When recycled parts are added to the original raw materials, this changes the requirements for the entire production process, starting with the machines. Cost reduction of the original input prices can thus create a compelling incentive for change.

The authors have highlighted several ways, financial institutions can support this transition "*...declining interest rate, extending the credit period, increasing the loan amount and relaxing repayment condition...*"(Yunyan & Biao, 2014) as incentives for companies to manage the transition to the circular economy. When these conditions apply for a whole industry, healthy competition can support a drive towards the circular economy. Plus, it would naturally also include enterprises along the whole value chain, causing positive cascading effects.

Stahel proposed over twenty years ago that governments need to create a legal framework for change to take root, like the taxing of non-renewable recourses. He admits that he "*...underestimated the inertia of public policy making...*" (Stahel, 2013). Nonetheless, increased raw material prices ought to force companies to look for alternatives.

Considering that the market offers a variety of other positive effects for companies that are producing circular products such as enhanced brand strength and attracting new customers, an adjustment to BPMN that enables Context-Oriented Process Modelling in the CE becomes increasingly essential.

5 Conclusion

In order to reach the SDGs on a global scale, the pressure to transform the linear economy into a circular one is very both critical and increasingly more urgent. Incorporating the possibility to enable the modelling community to share their thoughts about optimal process architectures on Level 5 or Level 4, as well as, creating best practice process models which are easily shareable through standardized BPMN models at the lower levels could be essential in sharing best practices and reaching the SDGs as fast as possible. From an historical perspective, the idea of lean manufacturing had a strong influence on how business processes were analyzed.

Today, as mentioned at the outset, principles which were originally conceived on the production lines of the automobile industry are now as commonly used in financial and service industries, where Business Process Management has been implemented and processes can now be modelled with the help of many varying tools. High level models such as process landscapes, but also low-level models, could be modelled with BPMN or even automated with the help of workflow engines to orchestrate processes across service providers, product, or part manufacturers.

However, when moving to such scenarios, the implementation suggestions of the circular economy which are currently envisioned and described with the help of non-

standardized graphical pictures such as those in Figure 1, are neither reusable models nor yet supported by the BPM tool providers.

Firstly, the circular layout of processes is not an option, and secondly and even more challenging, is the representation of material flows. BPMN currently supports message and sequence flows, but no material flows, which are intrinsically important in circular processes. Current investigations in CE are on the agenda of many manufacturing companies and accompanying financial incentives will add additional pressure to optimize processes in the manufacturing industries and, in the long run, ultimately design out waste. Given the need of SDGs and the financial incentives for enterprises to implement not only lean, but also clean thinking, the time has come where these very same manufacturing industries could profit from all the tools and methods of BPM which the service industry developed by incorporating lean thinking.

We have, and share, the hope, that a model-driven process adopted by the finance and service industry and transition to a comparable, context-oriented process modelling that incorporates CE objectives and thus circulate back enabling manufacturing industries to finally implement urgently needed lean and clean circular processes.

6 Limitations

This paper has several limitations and partially raises question without providing specific solutions. This paper is an invitation to evaluate BPMN in the context of circular economy principles. It is pointing out the need of additional views and shapes in modeling tools to improve the ability to model circular economies, circularity in process landscapes, circular processes and material flows. Future conversations with companies will deliver additional insights and help the authors better understand challenges of such a transformative transition. Additional publications will be necessary to shed more light into specific suggestions or potential enhancements of BPMN to support the transition to the circular economy.

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Sustainability orientation in Business Models of Swiss Start-ups

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Abstract. Research on Sustainable Busines Models of start-ups currently focuses on those which pursue a sustainability goal as a main aspect and at least also follow an ethical motivation, possibly in addition to the profit motive. This paper aims to firstly identify useful criteria for describing sustainability in business models and secondly does an investigation on the sustainability orientation and implementation in business models of participating start-ups in the Swiss Innovation Challenge, a business plan competition. As sustainability was no criterion in the application process, many of the start-ups didn't have a strong sustainability orientation. It will be examined to what extent these start-ups take sustainability aspects into account, and which ones in detail. Secondly, it is examined which business model types are used here in order to identify prevailing types and patterns for start-ups that are not selected for their sustainability orientation. The 25 start-up teams were interviewed with a semi-structured interview guide, including an evaluations of sustainability criteria. Almost all start-ups have a strong profit orientation and many also consider sustainability in their business model, though mostly with only one field of action. The linear business model is dominant and only few start-ups contribute to the circular economy. Another outcome of the survey is that the sustainable business model patterns should be adapted for this target group of start-ups not geared towards sustainability for future research.

Keywords: Sustainable Business Model, Circular Economy, Sustainable Entrepreneurship.

1 Introduction

As the impact of human activity on our planet becomes ever more threatening, it is becoming more necessary to incorporate sustainability not just incidentally, but comprehensively into our actions. Businesses play a major role here as they are important players in economic activity, both in terms of resource consumption and in terms of how we interact with each other. Thus, companies have a direct influence on the way humans live today and in the future. The traditionally dominant way of using resources to produce products and services and throwing them away after use is being challenged with new approaches such as the circular economy approach (PwC & WWF, 2021). Sustainable business is essential to keep our planet livable for future generations. The definition of sustainability published by the so called Brundtland Commission as early

as 1987, although general, is still catchy and accurate: "Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs." (World Commission on Environment and Development, 1987, p. 6). In this same Brundtland Report, companies are also held accountable, along with individuals, governments and other institutions (World Commission on Environment and Development, 1987).

Start-ups can make a contribution here - they have the opportunity to incorporate sustainability aspects into the business model from the very beginning. According to a study by the European Commission, 80% of the environmental impact is already determined in the design phase of a new product (European Commission, 2014). On the other hand, start-ups also face the challenge that they cannot yet foresee and manage the entire production cycle in the start-up process. This paper will address the contribution of start-ups that do not have a focus on sustainability. By numbers, this is the vast majority of start-ups. For an overview on the worldwide entrepreneurial activity see the yearly publication of the Global Entrepreneurship Monitor (Bosma et al., 2020).

In 2013, Boons and Lüdeke-Freund (Boons & Lüdeke-Freund, 2013 , S. 17) did a systematization of sustainability characteristics and identified a need for further research on the consideration of normative and sustainable aspects in the innovation process of companies. In the publications on sustainability and entrepreneurship of the last twenty years, the focus has generally been on start-ups or innovations in which a sustainability aspect (such as the development of renewable energy or a sharing platform) was the core of or explicitly the business idea, for example in (Schaltegger et al., 2016; Schaltegger & Wagner, 2011). In Boons and Lüdeke-Freund, social and environmental values should also be considered in the value proposition and the supply chain, the consumption and financial model should also be sustainable (Boons & Lüdeke-Freund, 2013). In reality, often only one of the sustainability aspects is considered, and improving sustainability is not always a declared goal of the start-ups (Schaltegger et al., 2018), but one aspect among several. In Stubbs and Cocklin, Sustainable Business Models take into account the benefits for all stakeholders and do not only focus on shareholder value, i.e. ultimately profit (Stubbs & Cocklin, 2008). However, there are strictly profit-oriented companies that (nevertheless?) contribute greatly to sustainability. Where to draw the line between sustainable and non-sustainable startups? A common understanding of a Sustainable Business Model is missing so far (Breuer et al., 2018).

Furthermore, several articles describing possible sustainable business models have been published in recent years. Here, too, authors assume that business models have a clear normative orientation and are generally primarily sustainability-oriented (H Breuer et al., 2018). Even though it is noted that sustainable innovations emerge in different ways and also develop randomly and with little guidance (Ahrend, 2019), the typology of sustainable business models in Ahrend and others assume that business ideas that are sustainability oriented at their core, e.g. in (Lüdeke-Freund et al., 2018). Research on the sustainability orientation and respective business models of start-ups that do not mainly or only randomly selected pursue a sustainability goal is still missing. This article aims to help close these gaps. Start-ups are considered that participated in the business plan competition “Swiss Innovation Challenge” (*Swiss Innovation Challenge*, 2021) and were not selected in this context on the basis of sustainability

orientation. Thus, these are start-ups that might happen to also pursue a sustainability aspect at the core of their business idea. For most participants, however, this is not the case, and sustainability aspects can be found as a secondary aspect, or not at all. The range of consideration of sustainability was wide, and this range will be mapped and examined here.

In this conference paper, the question is, on the one hand, to what extent these start-ups take sustainability aspects into account, and which ones in detail. On the other hand, it examines which business model types are used here in order to identify prevailing types and patterns. The results can help to understand the nature and approach of sustainability considerations for further research and to be able to promote sustainability overall with better support of the entrepreneurs.

Structure of the paper. First, a literature review will be used to conceptualize what criteria can be used to describe sustainability, how categories for business models can be developed, and how these can be assigned to startups. Subsequently, the 25 participants in the competition who were available for an interview on the topic of sustainability will be assessed on the basis of the criteria developed. Finally, the results of the study are evaluated and commented on.

Method. Personal interviews were conducted under the assumptions that firstly participants do not know a lot about sustainability criteria and often did not think about the implementation, and therefore explanations during the interviews are necessary. Secondly, the interviewees will not spend much time to do an assessment. The personal interviews took about one hour. The research procedure was explorative with the knowledge about sustainability contributions still growing. Interviews give the opportunity to flexibly include additional questions.

The interview transcripts were qualitatively analyzed. It is assumed that start-ups fit in categories of sustainability criteria. Business models were categorized by the interviewer (SDG, sectors, degree of sustainability orientation, business model types, …). Besides the descriptive quality for a single start-up, a simple statistical analysis facilitated the qualitative analysis as further information about the group of start-ups could be gathered and the single start-up could be positioned against the group.
Data collection took place with the registration for the Swiss Innovation Challenge 2020 and with a survey of the participants after the 2nd pitch. Data on sustainability orientation and intensity were collected. The interviewer made a rating on different sustainability topics with an ordinal scale ("does not apply at all" to "fully applies"). In addition, characteristics of the competition participants were collected that describe the business model. (See sections 2 and 3)

The semi-structured interview guide is aimed at the participants of the Swiss Innovation Challenge who were selected by the jury for the 2nd pitch. Both innovations that lead to the founding of a company (start-ups) and innovations in existing companies are incorporated. In the 2020 cohort, all participants who agreed to have the sustainability interviews were start-ups, though. The participants come from all over Switzerland and occasionally from neighboring countries. They are randomly distributed across different industries and business models.

The participants did not know anything about this research project on sustainability aspects prior to registration, which is why the selection at this application level is random. Participation in the interview is voluntary. Participation or refusal seemed to mostly depend on time availability, rather than interest in sustainability issues. A bias towards participants with greater interest cannot be ruled out, though, which is why conclusions for the population cannot be drawn. However, statements can be made about the group of interview participants. The interviewer was thoroughly introduced to the topic and the questions and possible answers were discussed. Since one colleague conducted all 25 interviews, the evaluation is consistent. The evaluation was additionally and independently reviewed by the project management.

2 Sustainable Entrepreneurship

For a later evaluation of the competition participants in terms of sustainability, possible forms of sustainability are first systematically described. It is not the aim to draw a sharp line between sustainable and non-sustainable business models. Because of the many forms of sustainability, this is also not readily possible. Rather, there are various sustainability criteria and these in different forms, so that it is better to create a kind of sustainability profile for each company under consideration. We start with the more general sustainability criteria and then become more specific.

There are numerous definitions of sustainable entrepreneurship. Like all entrepreneurs, sustainable entrepreneurs seek to identify, develop, and market a future business with a product or service - as in any startup or innovation project. In doing so, they take risks that they must manage for long-term success (York & Venkataraman, 2010). The terms entrepreneur and entrepreneurship are used broadly in this article. These are start-ups directly before, in the process of founding, or in the initial period after founding. Generally, we also include so-called intrapreneurship, i.e., the implementation of new, innovative business ideas in existing companies (Schaltegger & Wagner, 2011) even if we happen to have only start-ups among the interview participants in 2020.
Sustainable entrepreneurship is defined in this way:

"We view sustainable entrepreneurship as the discovery, creation, evaluation, and exploitation of opportunities to create future goods and services that is consistent with sustainable development goals." (Pacheco et al., 2010), or:

"An innovative, market-oriented and personality driven form of creating economic and societal value by means of break-through environmentally or socially beneficial market or institutional innovations". (Young & Tilley, 2006)

The first definition is quite general and refers to all corporate activities that are compatible with the Sustainable Development Goals (United Nations, 2016). Incompatibility with any of them is treated as an exclusion criterion. The second definition is on the one hand broad in terms of a general value creation, but on the other hand requires innovations that at least achieve a breakthrough in the environmental or social field and is thus stricter, as sustainability must be recognizable in the core of the business idea.

2.1 Motivation and profit orientation

Following this strong sustainability orientation, one characteristic mentioned in the literature is the motivation of the entrepreneurs. Sustainably oriented start-ups are often assumed to act at least also with ethical motives and with a sustainably oriented or values-based mission (Breuer & Lüdeke-Freund, 2018).

Looking at a whole range of sustainability-oriented startups, several motives are conceivable side by side in various forms. Ethical-sustainable motives stand alongside the satisfaction of realizing a self-developed business idea or bringing an innovation to market and the desire to generate income from the company's profits. Combinations are thus conceivable that include the motivation of profit orientation and the desire to create added value for the society (Alberti & Varon Garrido, 2017; Breuer & Lüdeke-Freund, 2018). There may or may not be a trade-off between the two motives. The social contribution may incur costs and reduce profits, for example by paying suppliers fairly. In the case of a technical innovation for example to reduce CO2 emissions, there is not necessarily a trade-off; the sustainability orientation is core to the business idea and at the same time does not reduce profit. In recent years the line between profit orientation and sustainability has become increasingly blurred, “hybrid firms” developed that combine characteristics from both (Alberti & Varon Garrido, 2017).

If several motives can stand side by side, the question arises as to the significance of sustainability orientation in the start-up process, as this motivation can possibly lead to a different approach and different business models. There are entrepreneurs who do not implement their business idea primarily out of an ethical drive or a sustainability-oriented mission, but who do consider sustainable aspects later when implementing their innovation (Boons & Lüdeke-Freund, 2013). In other words, they primarily want to be successful with an innovative business idea and generate profit, but do so while taking into account social and environmental needs (Thompson & MacMillan, 2010). For example, they consider ecological aspects in the energy supply for production and avoid CO2 emissions, or they design products that can be easily disassembled into individual parts and recycled. These entrepreneurs are thus aware of the sustainable challenges facing our society and explicitly incorporate sustainability aspects into their business model.

Following Breuer and Lüdeke-Freund (2018), we distinguish the following categories: Sustainability is firstly integrated as a single component, e.g. by replacing a conventional pre-product with a sustainable one. The company is externally motivated by regulations or competition or demands of the clientele. The organization as a whole is not involved or integrated in sustainability aspects.

Second, sustainability is systematically integrated with several components and at one point in the business operation, e.g. with replacement of an entire product line, other distribution channels or similar. There is no comprehensive integration in several business areas.

Third, in a basically conventional business idea, sustainability is strategically integrated with a comprehensive sustainability process and management, e.g., with coordinated Corporate Social Responsibilities activities or the consideration of the sustainability impacts of the entire company.

Finally, in the fourth category sustainable value creation is at the core of the business idea, e.g. with a product-as-a-service system to reduce environmental impact, or a social initiative to include disadvantaged people. The founders' own motivation is present and finds expression in a comprehensive consideration of further sustainability aspects in business operations.

While categories one to three can be thought of as a process in which a company increasingly integrates sustainability aspects, level four is not necessarily reached as a further step. For these characteristics, such extensive changes to the business model are necessary that companies would basically have to start over. However, this category is well suited for describing companies that consider sustainability orientation as the core of their business idea from the beginning.

All manifestations are basically compatible with profit orientation, even if this will not always have the same priority. The sustainable entrepreneurs thus have several motivations, which can be pronounced to different degrees: the ethical convictions, profit orientation and possibly others, in order to be able to run their company without subsidies in the long term. Profit orientation usually leads to growth and thus to a spread of ethically desired action. As mentioned above, a strong profit orientation can get in the way of strictly sustainability oriented business models (Thompson & MacMillan, 2010). In principle, however, both sides can be reconciled (Boons & Lüdeke-Freund, 2013) and influence each other. In the case of non-profit enterprises, the profit orientation is not present at all, while the ethical motivation for it is usually particularly pronounced. NPOs primarily pursue social and environmental goals (Sarango-Lalangui et al., 2018). Looking at start-ups, these can be social organizations, for example, whose operation is not intended from the outset as the main source of income for the people involved or founding the organization.

2.2 The Triple Bottom Line of sustainability

Sustainable or, better, sustainability-oriented entrepreneurship as this implies an intention or attitude, differs from entrepreneurship in general in several respects. Entrepreneurs who act sustainably pursue not only economic but also ecological and/or social goals. These are also grouped under non-economic goals, e.g. in (Shepherd & Patzelt, 2011). Today, this so-called triple bottom line approach has become generally accepted, whereas initially sustainability was only understood as a consideration of ecological aspects (Sarango-Lalangui et al., 2018).

The three aspects of economic, ecological and social sustainability are often not covered to the same extent. For example, something could be produced conventionally and be ecologically questionable, but make a good social contribution. A contribution to sustainability is then recognizable, and it should not be definitively decided at this point in the evaluations whether a company can basically be described as sustainable or not. All three sustainability aspects for positioning a business idea should not stand side by side, but be understood as interwoven and integrated components of society (DIN, 2020, pp. 17, 18). In terms of environmental sustainability, the product, technology or service should improve the achievement of environmental goals. Examples are the preservation of biodiversity, reduction of pollution, reduction of CO2 emissions,

efficient use of resources. Correspondingly, in terms of social sustainability, the product, technology, service should improve the achievement of social goals, like the consideration of the needs of the socially disadvantaged, poverty prevention, inclusion, development cooperation, fair treatment of employees and fair, non-discriminatory remuneration. Finally, in terms of economic sustainability, the product, technology or service should contribute to the economic strength of the country through entrepreneurial success. Through business activity, the production factors are remunerated (workforce, capital, other resources), and thus jobs and income are created for the population. This means that the contribution to the society is also considered in the economic sustainability aspect, and not just the profit orientation on the company level.

3 Sustainable business models

3.1 Sustainability in business models

In the last twenty years, the term "business model" has been shaped. The core feature is the description of a value creation, which is mentioned in many definitions. Osterwalder and Pigneur introduced the term Value Propositions. The business idea of a start-up or company should solve a problem for customers or satisfy their needs, respectively (Osterwalder & Pigneur, 2010). Based on this, they identified nine aspects, such as Customer Segments, Distribution Channels and others, which were clearly presented in the well-known Business Model Canvas.

Sustainability-oriented business models do not differ generally from the main criteria. However, sustainability aspects are integrated and presented. In summary, sustainability can thus be integrated into the definition of a business model (Schaltegger et al., 2016, p. 6):

"A business model for sustainability helps describing, analyzing, managing, and communicating (i) a company's sustainable value proposition to its customers, and all other stakeholders, (ii) how it creates and delivers this value, (iii) and how it captures economic value while maintaining or regenerating natural, social, and economic capital beyond its organizational boundaries. ”

The view on the society outside the company becomes clear and ecological and social aspects are explicitly integrated as well as other stakeholders are mentioned. Boons and Lüdeke-Freund emphasize that the topic of sustainability should be represented throughout the entire business process (Boons & Lüdeke-Freund, 2013). The value proposition should create a balance between the three aspects of economy, ecology and social issues. These aspects should also be recognizable in the supply chain and infrastructure. Customers and other stakeholders should be motivated to behave responsibly. And finally, the financial model should also take into account ecological and social framework conditions. Breuer, Fichter, Lüdeke-Freund, and Tiemann define four principles as minimum requirements for a Sustainable Business Model (SBM): sustainability orientation, value creation in a broader sense with a view to society, systemic thinking with, for example, an understanding of the circular economy, and stakeholder integration (H Breuer et al., 2018). They derive more concrete requirements for the

development of SBM, such as consideration of the context, possible collaboration, and taking into account the impacts and outcomes of the business activity.

3.2 The linear economic model and circular economy

For an analysis of the material flow, the question of the business model can be further differentiated from an ecological point of view: are resources returned to the economic cycle in the sense of the circular economy, or does the business model promote resource efficiency in the linear model, or possibly neither? This distinction and a differentiated view is useful to be able to identify typical business models that contribute to a more circular economy and thus promote sustainability. The circular economy is therefore a goal under the umbrella concept of sustainability. The focus of circular economy concepts is mainly on economy and ecology, less on social aspects (Murray et al., 2017). Social aspects can, of course, be additionally considered.

The linear economic model "Take - Make - Waste" is predominant today. Resources are used to make products that are thrown in the trash after use. In contrast, in the "cradle-to-cradle" approach, resources are used longer or are reused or reintroduced into the material cycle after the end of use – the circle economy (McDonough & Braungart, 2002). Further variations are possible if sustainable business ideas enable a more efficient use of resources in the linear economic model. For example, new technology can reduce material consumption or energy consumption in a production process. The linear economic model thus becomes more sustainable, but still leads to the discarding of goods that are no longer used. The linear model is increasingly reaching its limits, due to the scarcity of natural raw materials or the disposal of large amounts of waste containing valuable resources (Walcher & Leube, 2017). According to current estimates, only 8.6% of resources worldwide are regenerated in the sense of the circular economy, while more than 90%, accordingly, are not fed back into the material cycle (PwC-WWF, 2021).

3.3 The concept of circular economy in business models

The problem has now been recognized, and the transition of current global production patterns to a circular economy is being pursued by political actors. Approaches can be found, for example, in the European Commission, which presented an action plan for the circular economy in 2015 (European Commission, 2015). In addition to closing material cycles, it is also intended to enable improved innovation capacity, new jobs and sustained economic growth in general.

The term circular economy is used in different ways, and a general definition has yet to be developed. One well-known definition of the circular economy comes from the Ellen MacArthur Foundation, which defines it as "an industrial economy that is restorative or regenerative by intention and design" (Ellen MacArthur Foundation, 2013, p. 14). This understanding of the circular economy aims to maintain products, components, and materials at their highest utility and value. The circular economy concept emerged from industrial ecology, the blue economy, the product-service system

(Camilleri, 2019; Tukker, 2015) and the cradle-to-cradle approach (Ellen MacArthur Foundation, 2013; McDonough & Braungart, 2002; SATW, 2014).

In the current discussion, the circular economy is understood as a closed system of resource use that decouples economic growth from problems such as environmental pollution and limited resources (Geissdoerfer et al., 2017). Reuse or remanufacturing and recycling are mentioned as methods (see Fig. 1). According to the Ellen MacArthur Foundation, circular economy is defined as an economic system that is regenerative and aims to keep resources and (partial) products at the highest possible use for society. Consequently, burning the waste to recover energy should only be the last choice as the material is lost forever. In the literature, the term circular economy is often generally understood to mean a sustainability contribution to improving the use of resources, with the designs then distinguishing whether the material cycle is actually closed or slowed down in one way or another (Antikainen & Valkokari, 2016; Bocken, 2020; Henry et al., 2020). The different design forms will now be described in order to be able to assign business model patterns to them further below.

Nancy Bocken (2020) distinguishes between 'narrowing', 'slowing' and closing resource loops under the umbrella term circular economy. Narrowing refers to the reduction of resource consumption through more efficient use of energy and materials. One can also speak of efficiency improvements. This is not circular economy in the strict sense, since less is consumed, but nothing is said about reuse of resources. So we are still in the linear model here, with an improvement in sustainability through more efficient use.

Slowing down the resource cycle means using products for a longer period of time, whether through repair, second-hand sale to a new owner, or multiple use through a sharing model (like car sharing). Here, resources are put back into the economic cycle (Bocken, 2020).

Closing the loop means putting materials back into the economic cycle. The best-known example is recycling. Products are dismantled or made available in another form as raw materials (Bocken, 2020). This can also be related to the biological cycle as a regeneration when organic material is composted.

The "5 R" (Henry et al., 2020) Reduce, Reuse, Regenerate, Recycle, Recover can thus be assigned to these categories:

Table 1. own compilation with (Bocken, 2020; Henry et al., 2020)

Sustainable business model strategies	**Definition**	**narrowing, slowing, closing**	**Type circular or linear**
Reduce	Reduc e use of resources, efficient design and production	narrowing	linear
Reuse	Bring products back after initial use, repair, second-hand markets	slowing	circular in a broader sense/ finally linear

Regenerate	Benefits for and through the biological ecosystem, composting, green roofs, ..	closing	circular
Recycle	Process materials for using them again, upcycling, downcycling	closing	circular
Recover	Incinerate residuals and recover embodied energy, last option if others do not apply	closing	circular

The linear value chain and the circular economy can be mapped as follows.

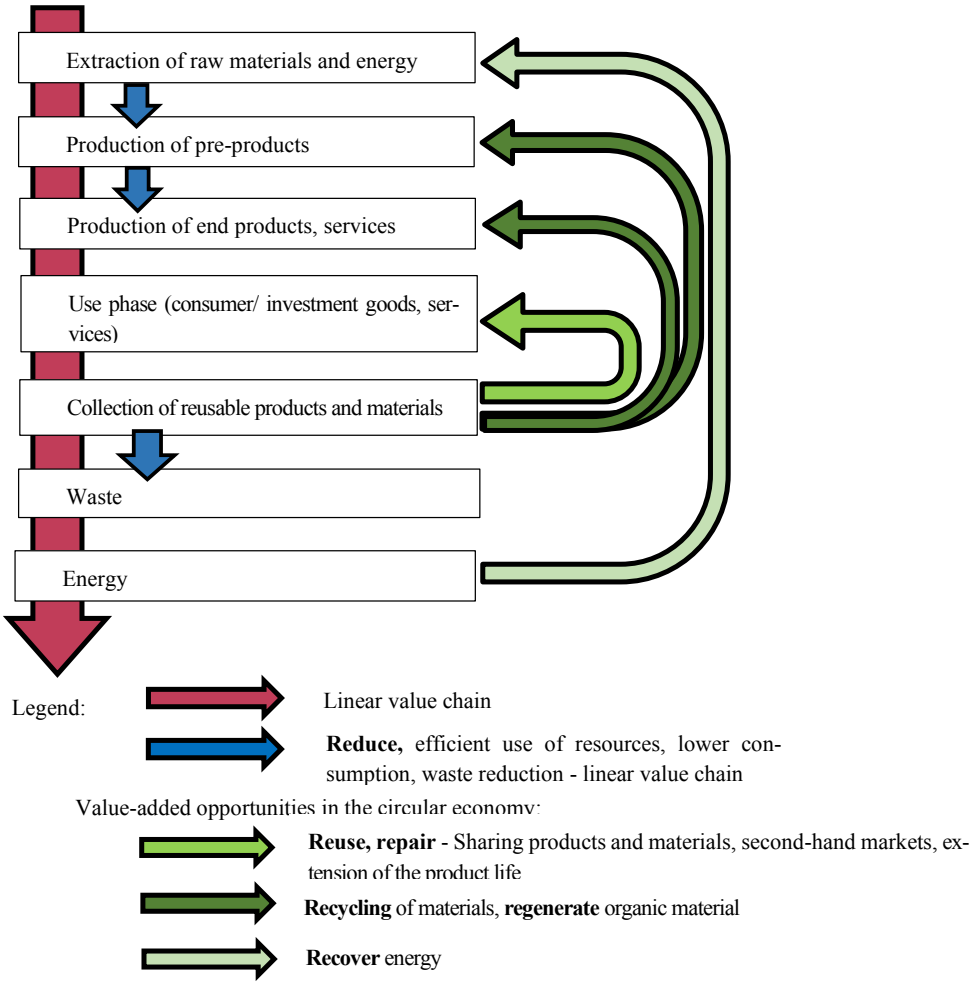

Fig. 1: Value creation opportunities in the circular economy, own illustration developed from (von Kutzschenbach & Milow, 2019).

To get a better overview of typical sustainability-oriented business models, companies can be further categorized according to their activity. These five types were identified: design-based, waste-based, platform-based, service-based and nature-based start-ups (Henry et al., 2020). However, the authors mainly have in mind start-ups with sustainability at their core. In another analysis, the categories were chosen more broadly so that many different sustainable business models could be represented. In an analysis 11 pattern groups with altogether 45 patterns very identified (Lüdeke-Freund et al., 2018). The idea was to have a rather complete picture of possible sustainability patterns in business models. The pattern groups will be used in this evaluation, with the detailed patterns providing further information about the categories.

Table 2. Sustainability patterns (pattern groups) in business models, following (Lüdeke-Freund et al., 2018)

Pattern	Description
G1 Pricing & Revenue Patterns	Addressing the revenue model of a business model, i.e., how offerings are priced and revenues generated. E.g. Differential pricing, freemium.
G2 Financing Patterns	Addressing the financing model within a business model, i.e., how equity, debt and operating capital are acquired. E.g. Microfinance, Crowd Funding.
G3 Ecodesign Patterns	Integration of ecological aspects into key activities and value propositions, i.e., how processes and offerings are designed to improve their ecological performance over their entire life cycle. Including reduction of resource use, higher efficiency.
G4 Closing-the-Loop Patterns	Integrating the idea of circular material and energy flows into partnerships, key activities, and customer channels, i.e., how materials and energy flow into, out of, and return to a company. E.g. Recycling, reuse, repair, take-back-management.
G5 Supply Chain Patterns	Modifying the upstream (partners, resources, capabilities) and/or downstream (customers, relationships, channels) components of a business model, i.e., how inputs are sourced and target groups are reached. E.g. shorter supply chains, produce on demand.
G6 Giving Patterns	Helping donate products or services to target groups in need, i.e., how costs are covered and social target groups are reached. E.g. buy-one-give-one.
G7 Access Provision Patterns	Creation of markets for otherwise neglected target groups, involving modified value propositions, channels, revenue, pricing and cost models, i.e., how value propositions are designed, delivered, and to whom. E.g. affordable housing, degrees.
G8 Social Mission Patterns	Integrating social target groups in need, including otherwise neglected groups, either as customers or productive partners, i.e., how customers, partners, and employees are defined and integrated. Including "high-tech for health" health improvement through innovative medical or pharmaceutical products

G9 Service & Performance Patterns	Emphasizing the functional and service value of products and that offer performance management, i.e., how value propositions are defined and delivered.
G10 Cooperative Patterns	Integrating a broad range of stakeholders as co-owners and co-managers, how partners are defined and how the organisation is governed. E.g. cooperative ownership.
G11 Community Platform Patterns	Patterns that substitute resource or product ownership with community-based access to resources and products, how value propositions are defined and delivered. E.g. sharing business.

These patterns are used to describe the main sustainability aspect of a business idea but do not incorporate information about the intensity or other sustainability aspects. It is therefore conceivable for a company to bring a technical innovation to market without any particular sustainability features and at the same time to treat its employees in a particularly social and participatory manner (social mission pattern). The pattern is not describing the whole business model but only the main sustainability aspect.

To sum up, a start-up's sustainability profile can be described with the general sustainability orientation, the contribution to the three pilars economic, ecologic, social, the degree of profit orientation, regarding ecologic sustainability with contributions to resource efficiency and the circular economy, in more detail described with the "5 R", and finally with typical sustainability patterns in business models.

An **Interview Guideline** was derived following the criteria just described. In a first section of the guideline the personal motivation and development of the business idea were addressed. Then the business concept and the business model were evaluated with the core topics of sustainability contribution according to the triple bottom line, the linear business model versus a circular economy concept with different characteristics and finally the business model patterns.

4 Evaluation of sustainability in the business models of Swiss Innovation Challenge participants

The entrepreneurial competitions under the brand Swiss Challenge were launched by the University of Applied Sciences and Arts Northwestern Switzerland (FHNW) in 2014 to provide practical education and training for both students and graduates. Entrepreneurial thinking and action of students and employees at university as well as beyond in business and society are promoted - participation in the competitions is open to start-ups in different entrepreneurial stages as well as too SME (FHNW, 2019b).

The Swiss Innovation Challenge lasts a total of eight months and includes three pitches of the participants with an evaluation of their business ideas and projects by a jury (FHNW, 2019a). During the competition, participants can attend free, user-oriented seminars. In addition, they have access to mentoring and coaching programs where they are supported and encouraged with practical knowledge. The data from the 2020 cohort were evaluated for this article. 25 teams in the second pitch were ready for an interview, which was conducted using a semi-structured interview guideline.

The contest participants are randomly distributed across different industries and business models. In this 2020 cohort, all participants were start-ups. The teams are planning an innovative business in the near future or they have started already within the last two calendar years. (Admission criteria, (FHNW, 2019a)).

First, the general sustainability orientation was examined. Being asked, some of the teams answered that they currently are too busy to deal with sustainability aspects, for example with interview partner 4 (I4). "At the moment, we are more focused on the economic goals, because as a young start-up, it is very important for us to be able to launch at some point and scale the business." Others started talking about their general sustainability attitude but could not find those aspects in their start-up, like I22: "Out activity is mostly online and environmental protection is not an issue for us. This is neither positive nor negative. Basically, environmental protection is something we consider important. For example, we travel as much as possible by public transport and not by private car, but otherwise there are actually few decisions in our business or there is little in the area of environmental protection that has an influence on our decisions."

Other interview partners instantly found some sustainability motives, some of them thought about before, others possibly recognized at the moment: "Ecological aspects are very important to us. We are a start-up that is already CO2-neutral. Which is also not a matter of course, since it also costs a certain amount. That's why it was important for us from the very beginning. We produce as much as possible in Switzerland. In addition to the ecological aspect, we also want to strengthen Switzerland as a business location with our product. A social aspect is that it is also extremely important for us to have a very good relationship within the team as well and that the employees can work very well." (I6)

The categories below were evaluated with the ranges from 0, not applicable, to 4, the core of the business idea.

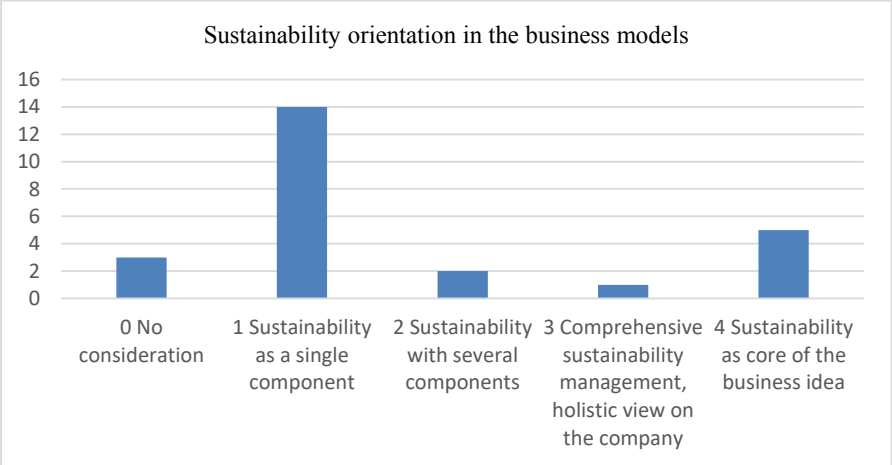

Fig. 2, sustainability orientation, own evaluation

While three of the 25 start-ups did not at all contribute to sustainability, 14 did so with a single component. For example, they use energy from renewable resources but otherwise did not implement sustainability aspects into their business operations or have a holistic sustainability approach. There were few companies in the mid-range but 20% (5) have an explicit sustainable business idea, like in I1: “The goal is petroleum substitution. There are basically two sources of carbon that could replace petroleum. That is CO2 from the air and plants, and we see a lot of potential in plants because we already have a lot of agriculture and the conversion will be much faster. That's why we've developed a process that can get petroleum-like molecules from plants.”

Next, the sustainability contribution of the products or services was closer examined with respect to the three pilars of sustainability. The projects were evaluated about their contribution to the economy, the ecology and/or to the society with a range of “not at all” to “high contribution” (0 to 4).

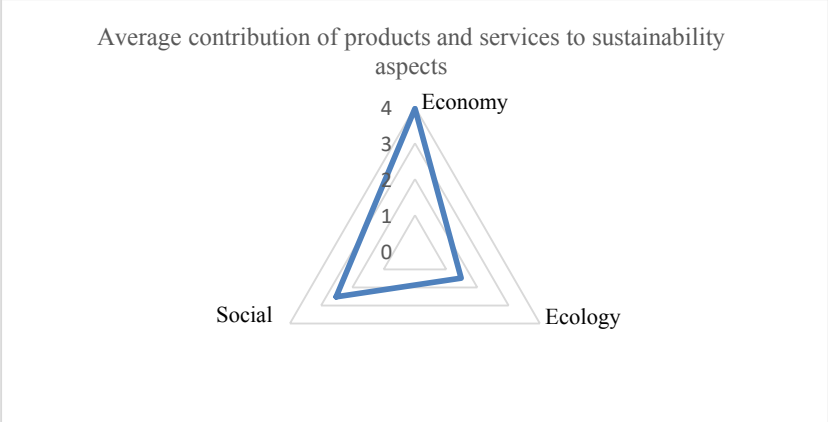

Fig. 3, contribution to three pilars of sustainability, own evaluation

While almost all start-ups have a strong economic focus, only some contribute to social sustainability and to a lesser extent, and even fewer to ecologic sustainability. This is in line with the profit orientation of the start-ups. The business models were categorized with respect to their profit orientation. We learnt above that this is not necessarily connected to sustainability orientation, and a fully profit oriented company can at the same time strongly contribute to sustainability. Still, there might be a relationship as the core sustainability oriented companies could be less profit oriented. With this evaluation a correlation could be examined in this group.

Quite a few interviewees were very clear about the profit orientation of their company. “We are purely profit driven. We believe that by building a company that tries to get an impact or the most out of these devices, we have the greatest impact this way.” (I15), or “We want to build a viable company. So simple…. At the moment, we are purely profit oriented.” (I2). One argument for a strong profit orientation can be the funding of expensive investments, “it takes so much money to build a new chemical plant (...) It would be several hundred million to build such a thing, and unfortunately

no one does that today without hoping that the thing will spit out the money again." (I1).

The interviewer discussed the topic with the participants and then decided the best fitting category from profit to non-profit orientation.

Table 3. Degrees of profit orientation

Profit orientation	**Number**
Profit oriented	12
Profit orientation first priority, among other goals	12
Mainly not profit oriented goals but want to make a profit, after all	1
Non-profit	0

We see that generally the interviewed participants were profit oriented but quite a few also follow other goals. The five start-ups that are very sustainability oriented (see above) obviously also have a strong profit orientation.

Next, the ecologic sustainability with respect to resource and energy efficiency in the linear model and contributions to the circular economy are examined. The interviews show that most of the start-ups have a linear business model. Some contribute to a very limited extent to the circular economy, like I5: "In the area of recycling, reuse, circulation (...) it is actually only the packaging that we bring back into the cycle and reuse. We also don't really have any waste from production that we could put back into the production process afterwards. That is actually all." Others argue that with producing a software, there is no material that could be reused or recycled, like I2 "by offering Software as a Service it is a linear business model." At the same time, I2 explains that in the linear model the company contributes to energy efficiency, "we are an enabler that our customers can plan more sustainable buildings. (...) In terms of CO2 reduction, [lower] energy consumption." Finally, few contribute to closing the resource loops, like I1 with an idea to replace fossil products, "The circular economy is one reason for our idea. If you need biomass from wood or agricultural waste, that's already CO2 that was in the air, then in the plant and you borrow it, so to speak."

The four categories are shown in the following table. Compared to table 1, the different types of actual circular economy business models are aggregated here in one category.

Table 4. Circular economy and linear economic model

Circular economy - linear economic model	**Number**
Linear economic model without sustainability contribution	15
Improve resource, energy efficiency – reduce, in the linear model	5
Slowing resource use: reuse, repair, (sharing, 2nd hand, …, still linear model)	1
Closing the Loops: recycling for new products, actual circular economy, regenerate (biological), recovery (energy).	4

Then, the circular economy business models were separated according to the "5 R", reduce, reuse, regenerate, recycle, recover. The picture was very similar to the previous table 4. All four start-ups with a circular business model were of the type "recycle".

For a more differentiated picture, the interviewed start-ups were categorized in terms of their sustainability patterns. Some patterns did not occur among the 25 participants, but others were particularly frequent.

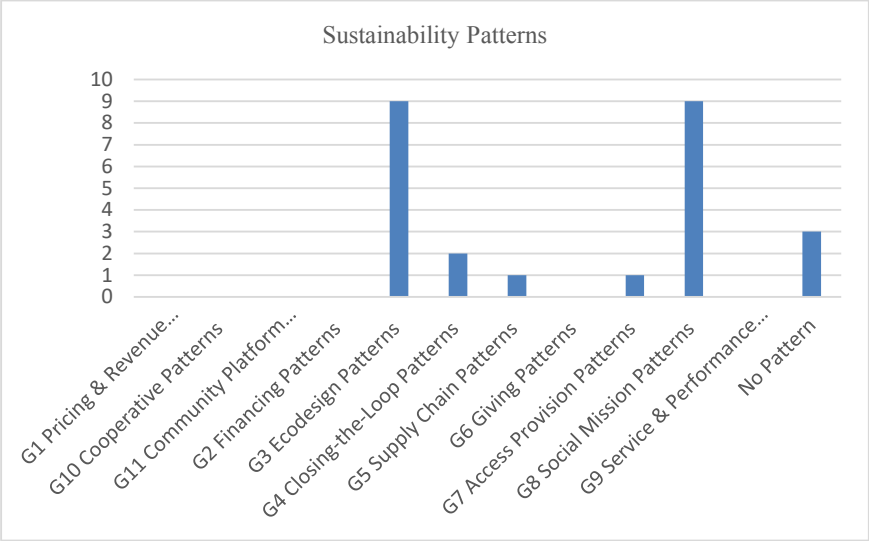

Fig. 4. Patterns of sustainable business models, own evaluation

There are two clusters in the pattern types, ecodesign and social mission patterns, with nine start-ups each. For the classification the strongest component determined the pattern category. A recyclable new waterproof membrane for outdoor clothing for example is both, an innovative ecodesign, and at the same time contributing to closing the resource loops. In this case, the ecodesign is regarded dominant. This explains that we found above four companies in the circular economy category, but here we have only two for the closing-the-loop pattern.

5 Discussion

The main question of this paper is to what extent the interviewed mostly conventional start-ups take sustainability aspects into account, and which ones in detail. The typical participant of the 25 teams that had been interviewed is profit oriented with some awareness of sustainability topics, but often this is only implemented in the business as a single component. There are also some few start-ups with a strong sustainability orientation. The mid-range seems to be almost missing – either they are implementing sustainability aspects to a large extent or not very much.

A social focus was more represented than an ecologic one, looking at the triple bottom line of sustainability. This is in line with the peak for social mission patterns. The social mission patterns include health improvements, here med-tech or pharmaceuticals. There were quite a few among the participants. And these typically do not contribute to a circular economy or a slowing or narrowing of the value chains. Consequently, we found a relatively high number of start-ups in the linear model with no such contribution.

Looking at the sustainability patterns in detail, we find in an analysis of ecological aspects another typical combination. Some Start-ups contribute to sustainability only with a single component, and this is often a reduction of resource, energy or carbon dioxide use, for example when using an electric car. Although this is no high level regarding overall achievable sustainability of a start-up and not a real innovation, these actions counted as ecodesign in the sub-pattern "substitute with renewable processes", as no other matching category was available. This explains the high number of ecodesign patterns. At the same time, we see that for further research the categories (Lüdeke-Freund et al., 2018) have to be revised to be applicable also for companies that do not have a strong sustainability focus.

Examining the results for the "5 R", the clusters of cases in the categories "reduce" and "recycle" (see table 4) is in line with results of an examination of 128 sustainability oriented business models (Henry et al., 2020) – here the accumulation of cases was in the same two categories. An interpretation could be that a reduction of resource or energy use is an easily reachable goal, and recycling seems to be the dominant way of implementing circular economy ideas. Further research could verify this.

6 Conclusion

The initial assumption that many of the competition participants do not follow a sustainability path as the core of their business model was confirmed. While the attitude of quite a few management teams was sustainability oriented, the implementation in the companies was mostly not advanced. Typical sustainability contributions and their intensity of the start-ups could be elaborated. Among the interview participants there were several with a social contribution in the health sector, while a group of other conventional start-ups only contribute with one energy-related aspect like carbon dioxide reduction. There was no broad range of circular economy business models. Further support and training for start-ups could encourage the implementation of these circular economy ideas that will help to make our planet livable also for future generations. The categories of this analysis turned out to be useful for describing the start-up' sustainability orientation. The sustainability patterns have to be revised, though, to better map business models with a less strong sustainability orientation.

Further research could evaluate the contribution of the business models to the United Nations' Sustainable Development Goals and include an analysis of the industries of the start-ups, combined with the sustainability patterns. Over the years, we will have more data in the Swiss Innovation Challenge for a more substantiated analysis. On an individual company's level, the sustainability criteria from this article could be used to

develop a profile for positioning, communication to the stakeholders and as an incentive to improve the weaker areas.

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Awareness on Financial Cybercrimes among Youth: Experience, Exposure and Effect

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Abstract. After converging into information technology in the last three decades, Malaysia has transformed into a regional Information Communication Technology (ICT) hub. Despite its bundle benefits to the user, the package comes together with related risk exposures and has gradually evolved since then. The purpose of this paper is to find out whether the constructs related to the awareness of youth in terms of experience, exposure, effects of financial cybercrime. This study adopts a quantitative approach by using Pearson's correlation analysis to explain the data which has been collected through a structured questionnaire. A total of 242 respondents have participated in this study via a convenience sampling method. The finding revealed that youth are reasonably aware of the financial cybercrimes based on the constructs used in this study. Although this research has been carefully prepared and achieved its goals, it is still known that researchers are limited and deficient. Firstly, the scope of analysis will likely be limited by the scarcity of evidence or reliable data. Most journals have found that there is a dearth of information on e-banking in Malaysia compared to other developing countries.

Keywords: *cybercrime, youth, financial, awareness*

1 Introduction

Financial technology nowadays has become one of the strength pillars to the growth of a nation. After converging into information technology in the last three decades, Malaysia has transformed into a regional ICT hub. As stated in Shared Prosperity Vision 2030, one of the biggest challenges refrained the nation from moving forward is due to the lack of participation among industrials in digital economy. Until recently, the outbreak of pandemic has caused stir to the global economic well-being and thus increased the usage of virtual transaction among users. The finance analyst, Jonathan Curtis, sees the boom effect of technological sector and makes his statement, 'the big opportunity in this space is digital transformation' (The Edge Markets, 2020).

Hitherto, the banking activities is in the traditional form of transaction such as cash payments, cheques, or bank drafts. Moving forward this trend has paved a way to a modern system of payment in the form of swiping of debit cards or credit cards. The adoption of financial technology is perceived as a cost-effective strategy and recognized for its privilege to bring greater efficiency and productivity. Many financial and non-financial institutions invest in technological invention to create an added value to the company and remain competitive in the years ahead.

Though the benefits of technology are undeniably robust, the weaknesses are just at par (Agrawal S., 2016). Technological advancement leads to digital invention of many opportunities to the economic activities. Despites its growing demand in technological sector, the financial cybercrimes also go on strike and show an increase trend since Movement Restricted Order (MCO). This is proven by the fact that the number of cybercrime attack has increased for the same period as MCO from March 18 to April 7 by 82.5% from 417 cases in year 2018, 459 cases in year 2019 and recently the cases has jumped to 838 (TheStar, 2020). As of this year, the total cybercrimes cases in April alone is 1488 and attain the highest fraud case (MyCert, 2020). While the banking sector was able to reach more customers with the emergence of advanced technology, it also increased the risk for customers, who often have doubts and insecurity regarding these services.

There are several types of cyber-criminal activity which has been recognized as serious crime in Malaysia such as cyber harassment, intrusion attempt, intrusion, vulnerabilities report, denial of service, fraud, malicious codes, spam, and content related. The laws regulated purposely for cybercrime are as follows; Computer Crime Act 1997, Communications and Multimedia Act 1998, Malaysian Communications and Multimedia Commission Act 1998, Digital Signature Act 1997, Copyright Act (Amendment) 1997, Telemedicine Act 1997, Optical Disc Act 2000 and Electronic Transactions Act (2006). As part of initiative to counter the rising cybercrime cases, it is important to educate the young generations on awareness about cyber law and regulations (Chanuvai Narahari & Shah, 2016).

At present, cybercrime is a growing threat and is most prevalent in the digital world since individuals and groups rely more on information technology to finish off the dealings with faster transaction such as online banking over automated teller machines (ATM). The rapid use of the internet and other technology in the banking sector has increased the likelihood of cyber threat across the world such as scammers, phishing, hacking etc. Hence, it is necessary for researchers to investigate and review the cybercrime scenario in a country because it is new in Malaysia. The user of financial technology has no age limit, thus vast number of people will find this study helpful for them especially related industry such as technological sector to come up with defensive blocking system due to increasing cybercrime cases in financial sector, youth who actively connected to the internet, government agencies and public institutions. The purpose of this paper is to find out on the constructs related to the youth awareness on financial cybercrimes in terms of, experience, exposure, and effects.

2 Literature Review

2.1 Financial cybercrimes

Though technology makes thing easier, effective, and efficient, the misuse of technology by some irresponsible parties has led to a gruesome situation. Besides, the age of a person is not a pre-requisite from being a victim of this growing concern issue. Together in this, Amro (2017) said, "with an increasing number of individuals staying in touch using mobile devices, cyber threats are becoming increasingly prevalent among all age groups." It is well explained by Albert (2018), who emphasized the responsibility of young generation to protect older adults from being a victim of cybercrime as nowadays they are the most vulnerable target aimed by cybercriminals. Therefore, the youth should be playing the role and well-adapted with knowledge to exercise the duty.

As described by Agrawal S. (2016), internet banking users should stay cautious from financial cybercrime and be able to avert fraud and take a necessary step for security mechanisms so that they do not become victims of cybercrimes. In another part of the world, cybercrime cases in Africa also depicting a rising figure as evidenced by the country's annual losses to cybercrimes were estimated for Nigeria at $649 million, and Kenya at $210 million. In pursuance to this issue, Kshetri (2019) offered his thought in cybersecurity legislation and enforcement measures in the continent to further counter the rising cases.

This study adopts Routine Activity Theory (RAT) and Lifestyle Exposure Theory (LET) in the study as it ideally clarified cyber criminology and its consequences to the young and youth age. According to the Leukfeldt & Yar (2016) and Williams et al. (2019), the former theory is explaining victimization of cybercrime and its connection to the business cybercrime. On the other hand, the latter suggests that different lifestyle may expose people to different circumstances and it ends up getting into crime-prone situations which lead to a higher risk of victimization (Elly, n.d.). Rendering to Mugari, Gona, Maunga, & Chiyambiro, (2016), several types of cybercrimes such as hacking, phishing, identity theft and malware are amongst the threat of financial sectors in Zimbabwe. As conformed by Chevers (2019), who perceive the usage and frequency of using electronic banking are influenced by the first three crimes mentioned earlier as negative impact to adoption of electronic banking due to its continual escalation in financial cybercrime.

2.2 The experience of financial cybercrimes

As demand for access to online banking continues to increase and many customers rely on technology at fingertip for managing their finances, banks and other financial service companies would ensure that these transactions are convenient to perform. In a study conducted by Virtanen (2017), he summarized that, "experiences with hacked accounts

or cyberattacks also intensifies the fear of those with low confidence more than those with a higher amount of confidence." Therefore, he stands on his argument that social and physical vulnerabilities as well as victimization have direct and indirect effects on fear of cybercrime.

It is fairly important to be able to study on the likelihood behavior to become a victim of cybercrime. Van de Weijer & Leukfeldt (2017) agreed that only individuals with higher scores on openness to experience have higher odds of becoming a victim of cyber-enabled crimes.

$\mathbf{H_0}$: Victim experience has no significant correlation to the youth awareness on financial cybercrimes

$\mathbf{H_1}$: Victim experience has significant correlation to the youth awareness on financial cybercrime

2.3 The exposure of financial cybercrimes

The existence of cybercrimes has generated element of risk exposure that give effects to the personal harm and organizational harm. According to Verma, Hussain & Kushwah (2012), the risk exposure includes several items which are financial losses, regulatory issues, data breach liabilities, damage to brand and reputation, and loss of client and public confidence. Exposure is perceived as one of the major components to be victimised in cybercrimes (Phillips, 2015).

$\mathbf{H_0}$: The risk exposure of using electronic banking has no significant correlation to the youth awareness of financial cybercrime

$\mathbf{H_2}$: The risk exposure of using electronic banking has significant correlation to the youth awareness of financial cybercrime

2.4 The effects of financial cybercrimes

The person who involve in making the cybercriminals have developed advanced technique that increase the types of cybercrimes such as spying the business activities and access important business information which indirect impacts the bank's finances. This is supported by who has similar views on the impact of cybercrimes towards financial activities. The effects of a single, successful cyber-attack can have far-reaching implications, including financial losses, theft of intellectual property, and loss of consumer confidence and trust.

Becoming the victim of cybercrimes can have a long-lasting effect in an individual's life. In a study investigated by Kaakinen, Keipi, Räsänen, & Oksanen (2018), the result indicated as per se, "analogously to crime victimization in the offline context, cybercrime is a harmful experience whose negative effects mainly concern those users who have weak social ties offline to aid in coping with such stressors."

$\mathbf{H_0}$: Acknowledge the effect of using electronic banking has no significant correlation to the youth awareness on financial cybercrimes

$\mathbf{H_3}$: Acknowledge the effect of using electronic banking has significant correlation to the youth awareness on financial cybercrimes

3 Method

3.1 Research Design

This study is conducted in a quantitative manner. The aim of the study was to determine whether fourth-year students in the Faculty of Entrepreneurship and Business (FKP) at University Malaysia Kelantan's City Campus were aware of cybercrimes involving the e-banking system. In this report, descriptive and correlation analysis were used. As interpreted, the intention of the analysis was to investigate the relationship between the motives and the independent variables.

3.2 Unit of Analysis

The unit of analysis of this research will be the fourth-year students in Faculty of Entrepreneurship and Business at University Malaysia Kelantan. The respondents involved are the student selected courses, such as Logistics, Islamic Banking and Finance, Commerce and Retail, who are most likely using e-banking system.

3.3 Quantitative Research

A sample size can be defined as a subset of population. According to Roscoe (1975), sample size larger than 30 and less than 500 are appropriate for most research. By studying the samples, (Sekaran, 2010) has verbalized that the researcher should be able to meet the interest of the population. Since the total number of elements in the population frame cannot be ascertained due to unavailability of data, a precise number of samples cannot be drawn to represent the population.

Table 1: Krejcie and Morgan Sample Size Table

Table for Determining Sample Size of a Known Population

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	346
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	354
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	191	1200	291	6000	361
45	40	170	118	400	196	1300	297	7000	364
50	44	180	123	420	201	1400	302	8000	367
55	48	190	127	440	205	1500	306	9000	368
60	52	200	132	460	210	1600	310	10000	370
65	56	210	136	480	214	1700	313	15000	375
70	59	220	140	500	217	1800	317	20000	377
75	63	230	144	550	226	1900	320	30000	379
80	66	240	148	600	234	2000	322	40000	380
85	70	250	152	650	242	2200	327	50000	381
90	73	260	155	700	248	2400	331	75000	382
95	76	270	159	750	254	2600	335	1000000	384

Note: N is Population Size; S is Sample Size *Source: Krejcie & Morgan, 1970*

Based on Krejcie and Morgan (1970) table above, researcher will select 242 students as a sample from the total of 681 students. The respondents will answer the questionnaire itemized on the awareness of cybercrimes involved in the e-banking system among fourth year students in Faculty of Entrepreneurship and Business at University Malaysia Kelantan.

3.4 Development of Questionnaire

There are three sections in this questionnaire. First is section A which will discuss about the background of the respondents. Then, section B contains the question about the dependent variables (generally). Lastly, Section C, D and E explains the questionnaire item on each independent variable; the experience of cybercrimes in e-banking, exposure of cybercrimes in e-banking and effect of cybercrimes in e-banking. All the items to be included in the questionnaire were set on three points of scale, which is interpreted such as:

3.5 Data Analysis Procedure

Research data are collected frequently either by qualitative or quantitative methods (Hawe, Degeling, Hall, 1990). Questionnaires, surveys, and other quantitative approaches are used to collect data. According to Babbie (2010), numerical data and generalization across groups of people are collected and explained in a quantitative research. According to Avasarikar (2007), primary data is a term for data collected for a specific purpose, such as the preferences of researchers' requirements for any research problems.

The researcher uses a questionnaire method to gather all information in this research. Usually, questionnaire approaches are less costly and easier to perform. They are also relatively easy to implement because they are structured and free of many forms of error. It is usually intended for large amounts of quantitative data collection. A set of questionnaires will be distributed to the students. Respondents will be asked to answer all the questions in a timely manner. Respondents are also aided in clarifying the questions.

The data collected from the survey questionnaire will be calculated and evaluated with software version 23.0 of the Statistical Social Science Package (SPSS). The analysis of the data will be construed as two stages. The first phase of the data analysis includes the conduct of an analysis of the data to examine the data before any statistical procedures are adopted. The raw results, average values and relative values are calculated for each respondent. These data are the basis for further analysis.

3.6 Validity and Reliability

The concepts of validity and reliability were also used in this study. It is to understand how to minimize the possibility of errors and tendencies by increasing the data's reliability and validity. Conferring to Messick (1989), validity evolved into a complicated

concept. It is more closely related to the conclusion based on the assessment results. That is more focused on the outcome of the speculation that makes it implied. This evaluating consideration must be accurate and declare the truth. The assessment or evaluation should not be valid; only the assumption about this evaluation should be valid. Reliability coefficient assesses the consistency of the entire scale with Cronbach's Alpha being the most widely used measure (Nunnally, 1979). On other hand, the validity is the extent to which an instrument measures it is supposed to measure (Wiersma, 2000).

4 Results

After collecting the data from the respondents, the results of the research are started to analyze. To do so, the results collected from the distributed questionnaires were entered into the Statistical Package for Social Science (SPSS) version 23.0. Section A, which is the demographic part is first to be analyzed according to the questionnaire, that consist of gender, age, race, course and where do they access internet the most. Then, section B, C, D and E where it includes the Likert Scale measurement for every question asked to assess youths' understanding towards financial cybercrime.

4.1 Cronbach's Alpha

As shown in the Table 1, Cronbach's alpha is used to measure internal consistency or reliability of the items. To understand whether the questions in this questionnaire all are reliably measured the same latent variable, a Cronbach's alpha was measured on a sample size of 30 respondents.

Table 2: Cronbach's Alpha Coefficient Range

No	Coefficient of Cronbach's Alpha	Reliability Level
1	More than 0.90	Excellent
2	0.80-0.89	Good
3	0.70-0.79	Acceptable
4	0.60-0.69	Questionable
5	0.50-0.59	Poor
6	Less than 0.59	Unacceptable

The overall result of Cronbach's alpha is **0.974**, which indicates too high as it may have similarity and overlapping of the items since the suggested alpha value should be in within 0.65 to 0.95 (Piaw, 2012).

Table 3: Reliability Statistics

Cronbach's Alpha	N of Items
.974	20

4.2 Demographic Profile

Demographic profile is used to describe the phenomenon of a variable. In this study, categorical variables such as nominal and dichotomous were used to further assess the background of the sample such as gender, age, race, and internet accessibility.

Table 4: Demographic Analysis

No.	Profile	Description	Frequency	Percentage (%)
1.	Gender	Male	81	33.5
		Female	161	66.5
2.	Age	16-20	124	51.2
		21-25	103	42.6
		26-30	15	6.2
3.	Race	Malay	185	76.4
		Chinese	34	14.0
		Indian	21	8.7
		Others	2	0.8
4.	Internet sources	Home	69	28.5
		College	165	68.2
		Cyber café	1	0.4
		Others	7	2.9

Table 3 demonstrated a summarization of frequency analysis for 242 respondents who had participated in this survey. Firstly, most of the respondents are female which constitutes 66.5% (161 respondents), while male consists of 33.5 % (81 respondents). Meanwhile, majority of them aged from 16 to 20 years old with 51.2 % (124 respondents), followed by those who aged 21 to 25 years old with 42.6% (103 respondents) and the rest is 6.2% (15 respondents).

Of the total respondents, 76.4 % (185 respondent) answered by Malay respondents compared to Chinese with 14 % (34 respondents) and 8.7% (21 respondents) among

Indian. The remaining of 0.8 % (2 respondents) were from other races. This can be concluded that Malay was most of the youth population in the community.

According to the respondents, many of them get access to the internet from college approximately 68.2 % (165 respondents), then home is the second place where they highly accessed the internet constitutes of 28.5 % (69 respondents), while 2.9 % of respondents prefer other places to access (7 respondents and lastly access at cyber cafe with 0.4 % (1 respondents). Therefore, those who are staying in the campus are the most users of internet.

4.3 Descriptive Analysis

Descriptive analysis is a method used by researchers to identify the number in statistical interpretations and sum of the value. This study relies on mean and standard deviations to explain the measure of dispersion.

Table 5: Result of Descriptive Statistic

Variables	Mean	Std. Deviation
Influenced factors		
Experience (IV1)	3.11	0.462
Exposure (IV2)	3.34	0.481
Effect (IV3)	3.29	0.503
Awareness of cybercrimes	3.23	0.491

The table above shows, the summary of descriptive statistics of the influenced factors in this study. From the results, the highest mean belongs to exposure which obtain 3.34 while the lowest mean is 3.11 for experience factor. Meanwhile the effect factor shows the strongest dispersion of 0.503 and the lowest is experience at 0.462. The average dispersion measured by these analyses are 3.23 and 0.491, respectively.

4.4 Pearson Correlation Analysis

As part of inferential analysis, its purpose is seen important to describe the characteristics of the research subjects by identifying the relationship of the variables. SPSS is used in this part to analyze if there exist a strong strength of association between the two variables involved. Along this line, the dependent variable of the research is youth awareness towards financial cybercrimes while the independent variable is experience, exposures, and effects.

Table 6: Rule of Thumb for Interpreting the Size of a Correlation Coefficient

Size of Correlation	Interpretation
.90 to 1.00 (−.90 to −1.00)	Very high positive (negative) correlation
.70 to .90 (−.70 to −.90)	High positive (negative) correlation
.50 to .70 (−.50 to −.70)	Moderate positive (negative) correlation
.30 to .50 (−.30 to −.50)	Low positive (negative) correlation
.00 to .30 (.00 to −.30)	negligible correlation

Table 3 portrays the rule of thumb for interpreting the size of a correlation coefficient as it describes the strength of the relationship among the variables. The connection coefficient or allude as r. If value of r is +1.0, there is an impeccable positive relationship and if the estimation of r is -0.1, it immaculate the negative relationship of the factors. When the point estimation is r=0, it is demonstrated as no relationship between the factors of the research.

		Awareness
Experience	Pearson Correlation	.651**
	Sig. (2-tailed)	.000
	N	242
Exposure	Pearson Correlation	.589**
	Sig. (2-tailed)	.000
	N	242
Effect	Pearson Correlation	.503**
	Sig. (2-tailed)	.000
	N	242

The value of correlation coefficient for awareness of youth and experience is 0.651 which indicates a moderate relationship. The p-value is significant at 0.000 which is lower than 0.01. From the results attained, it can be concluded that experience has positive strength of relationship to the awareness of financial cybercrime among youth. Therefore, this be can concluded that $\mathbf{H_1}$ is accepted.

Meanwhile, the value of correlation coefficient for awareness of youth towards exposure of cybercrime is 0.589 and thus defines moderate relationship for both of variables. The p-value is 0.000 which is lower than 0.01. As stated in the table above, there

exists a positive strength between exposure and awareness of financial cybercrimes which explains. Thus, **H_2** is accepted.

The above table specifies on the value of correlation coefficient between awareness of youth and effects of cybercrime is 0.503 which implies moderate relationship. The p-value is significant at 0.000 since it is lower than 0.01. Again, **H_3** is accepted.

The questionnaires were first analyzed by using Cronbach Alpha. Back to the main purpose of this study is to test the strength of relationship between experiences, exposures and effects towards youth awareness in virtual transaction. From the result, the relationship strength of all independent variable towards the dependent variable is moderately correlated with r = 0.651 (experiences), r = 0.589 (exposures) and r = 0.503 (effects) which is significant at the 0.01 level (2-tailed). It seems to suggest that all the independent variable are the factors that represent the youth awareness towards financial cybercrimes. To sum up, all the hypotheses are significant and accepted. These hypotheses have significant values of 0.000 which are less than 0.05.

5 Conclusion

This chapter will discuss and review the result and supported by the previous study. A total of 242 questionnaires were distributed to University Malaysia Kelantan students (UMK). Initially, a reliability test was used to analyze the questionnaires. The demographic profile was then examined by using frequency analysis such as gender, age, race, course, and internet sources.

The population of students has been evaluated to address the phenomenon at university level in the matter of financial cybercrimes. The demographic profile shows that 33.5% of those interviewed come from men and 66.5% from women. Furthermore, 124 people (51.2%) are between 21 and 22 years of age and less than 25 years of age and above are respondents. 185 (76.4 percent) respondents reported that they were Malay. Each course excludes 24.4% retail course while others remain at 25.2% per course. In addition, most of them have internet connectivity in the university.

In this research, the hypothesis is to test the relationship between experience, exposure, and effect of using electronic banking towards awareness in financial cybercrimes. The relationships between all independent variables and dependent variable are correlated by the hypothesis, which are important at the 0.01 level, to r = 0.650 (experiences), to r = 0.589 (exposures) and to r = 0.503 (effects). This makes it clear that all the factors are associated to the awareness in cybercrimes. All hypotheses are substantial and accepted in summary. To conclude, the cybersecurity is becoming an intense headline nowadays since it is in high demand due to increasing figure of cybercrime cases. The drive towards Fourth Industrialization Revolution (IR 4.0) will come together with risk of cyberattacks. Thus, the call for adopting a common language and framework around cybersecurity should be exercised immediately before losing more to it.

Furthermore, strong cybercrime governance and legislation and policies with specific emphasis on tackling electronic channel-based fraud. Organization require a comprehensive enterprise-wide approach to cybercrime management that supports broader organizational compliance and risk management. The path to this approach includes an information technology (IT) infrastructure that enables enterprise-wide, real time, and cross-channel monitoring and management capabilities. Bank institutions should work towards developing digital forensic auditors.

Although this research has been carefully prepared and achieved its goals, it is still known that researchers are limited and deficient. Firstly, the scope of analysis will likely be limited by scarcity of evidence or reliable data. Most journals have found that there is a dearth of information on e-banking in Malaysia compared to other developing countries. Moreover, the studies affect only 242 students at the Malaysia Kelantan University, the City Campus as a sample and do not represent the entire population at Kelantan University. A wide range of research is therefore recommended and preferable. The limitation issue that occurs in this research should be addressed in future research. If the scope of the study is wider, the results of the research are better and the community such as students and staff can benefit significantly. Conversely, the study should be conducted using a qualitative approach, in which the researcher will interview the respondent to obtain knowledge from their own perspective about their own experience, how aware they are of cybercrime, and what impact cybercrime has had on them.

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The Development of *Maqasid Shari'ah*-based Performance Measurement of Islamic Banks: A Review

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Abstract. This paper reviews and revisits the existing studies on the development and application of *Maqasid Shari'ah-based* in measuring Islamic banks' performance. At present there is very limited rigorous research on the application of *Maqasid Shari'ah* and the performance of Islamic banks. Despite this situation, past empirical papers relating to the application of *Maqasid Shari'ah* in measuring the performance of Islamic banks were selected for review and analysis. The literature review shows that the past study on the development of the *Maqasid Shari'ah-based* in measuring the performance of Islamic banks primarily refers to the pioneering work of Mohammed et al. (2008) and the development of the *Maqasid Shari'ah-based* index mostly focus on the component of necessities of the *Maslahah.* There is a dearth of study that provides empirical evidence on the Islamic banks' performance using the *Maqasid Shari'ah-based* index and measurement. This paper addresses the pattern and literature gaps on the past study on the *Maqasid Shari'ah-based* performance measurement that would serve the interest of the academic researchers, practitioners, regulators, and policymakers in reviewing Islamic banks' performance in attaining the objectives of *Shari'ah.*

Keywords: Islamic Banks, Performance, *Maqasid Shari'ah*

1 Introduction

Despite the unsustainability of the first Islamic interest-free bank, Mit Ghmar, Egypt, that was established in 1963, the Islamic banking industry has been growing tremendously across the globe. The Mit Ghmar project serves as a kickstart for the development of the Islamic banking industry. An inter-governmental Islamic bank Islamic Development Bank was later established in 1975 in the effort to promote social and economic growth in the member countries and Muslim communities across the globe. Today, the Islamic banking industry is the major player of the Islamic finance industry in

which it contributes about 69% of the total assets or USD 1,993 billion of the global Islamic finance industry with annual growth of 14%, consisting of 526 Islamic banks, including windows, in 72 countries across the world. Currently, Islamic banks' assets contribute 6% to the total global banking assets [1]. It has been growing fast and tremendously in contributing to the economic and social sectors.

Along with the Islamic banking industry's growth, Islamic banks need performance measurement that depicts Islamic banks' true performance in achieving their mission and vision since Islamic banks have different concepts and practices from the conventional banks [2]. Nevertheless, the debate on the ideal measurement of Islamic banks' performance has been prolonging for many years. Islamic banks are overwhelming with the issue of inadequate and insufficient performance measurements that could cater to their unique characteristics and aberrant features. Most of the past studies focus using financial performance using similar measurements that have been used in measuring the performance of conventional banks, including ratios of profitability, efficiency, earnings, liquidity, credit risk and assets activity [3-20]. These measures, however, lack and insufficient in capturing the unique philosophies and principles of Islamic banks have achieved the *maqasid Shari'ah*. Islamic banks also need performance measurement that could cater to both shareholder and stakeholder interest in the forms of financial and non-financial ratios [21]. Islamic banking principles are underpinned by Islamic economic philosophy derived from *Shari'ah*, where the sources are divine revelations are from the Quran and Sunnah. Thus, the vision and mission of Islamic banks' business activities should be aligned towards attaining the objectives of *Shari'ah* (*maqasid Shari'ah*) [22].

However, there is still a dearth of literature concerning the usage of *maqasid Shari'ah* in Islamic banks' performance measurements. Past research on the performance measurements of Islamic banks is basically still tied to the measurements that have been used in measuring the performance of conventional banks. Hence, it is believed that *maqasid Shari'ah* shapes a critical influence on Islamic banks' performance as the Islamic banks' core business strives to offer the financial products and services that are *Shari'ah* compliance. Therefore, with the apparent relation between *maqasid Shari'ah* and Islamic banks, this study reviews the application of the *maqasid Shari'ah* explicitly relating to the development of performance measurements of Islamic banks.

2 Definition of Maqasid *Shari'ah*

The term *maqasid* is a plural word of the word maqṣad (singular) which literally means purpose, goal and objective [21]. Thus, the term maqasid *Shari'ah* means the purposes, goals or objectives of *Shari'ah*. Al-Ghazali states that the ultimate objective of *Shari'ah* encompasses the safeguarding these five cores which faith (*din*), self (*nafs*), intellect (*'aql*), posterity (*nasl*) and wealth(*mal*) that are considered as primary (*al-asliyyah*) in which others are referred as corollaries (*tabi'ah*) [21]. The omission of these five cores will bring harm to society. Al-Ghazali emphasizes the importance of preserving the maqasid *Shari'ah* as the fundamental meaning of maslahah [23]. Al- Shatibi further

interpreted the work of Al-Ghazali and classified it into three categories which are essential (*daruriyat*), complementary (*hajiyat*) and embellishment (*tahsiniyat*). The essential consists of those five elements: faith, life, intellect, posterity, and wealth that are regarded as necessary for the proper functioning of people's religious and ordinary affairs. The complementary complements the essential part whereby it is needed to alleviate the hardship and the embellishment refers to the those that lead to the refinement and perfection in the customs and conduct of people at all levels of achievement [24].

Meanwhile, according to Ibn Ashur, two general elements underlie *maqasid Shari'ah* which are the promotion of welfare (*jalb al-masalih*) and evasion of evil (*dar'a al-mafasid*) in which it clearly covers the promotion of welfare, combat against corruption, prudent usage of natural resources and enhancement of Islamic lifestyle [25]. Ibn Ashur's definition of *maqasid Shari'ah* foregathers the final objective of Islam whereby the benefits of individuals are guaranteed in the society that is guarded with the highest level of welfare [26]. Therefore, the authors further add those Islamic financial institutions, including Islamic banks, are supposed to be aligned with the *maqasid Shari'ah* as these institutions have idiosyncratic features such as elimination of interest, pursuance of public interest, nurturing economic well-being, promotion of social and economic justice and equitable distribution of income which are encompassed in the *maqasid Shari'ah* [26]. Abu Zahra extends the *maqasid Shari'ah* by including the components of education and justice and categorizes *maqasid Shariah* into three broader categories which are educating the individual (*Tahdhib al-Fard*), the establishment of justice (*Iqamah al- Adli*), and promotion of public interest (*al-Maslahah*) [27, 28, 29]. The promotion of public interest covers the components of complementary (*hajiyat*), necessity or essential (*daruriyat*) and embellishment (*tahsiniyat*) [26, 29].

3 *Maqasid Shari'ah*-based Performance Measurement and Islamic Banks

The previous research on Islamic banks' performance is still scarce and limited. Still, there is also a lack of studies investigating the elements of *maqasid Shari'ah* in the performance measurement of Islamic banks [21]. Moreover, none of the previous studies on the Islamic banking performance measurement combine both financial and religious aspects that are related to the characteristics of Islamic banks. Both performance measurement and the objective have a direct relationship; hence, maqasid *Shari'ah*-based performance measurement is essential in determining whether Islamic banks have achieved their ultimate objectives of *Shari'ah* [29].

A work of Mohammed et al. [27] pioneer the development of *maqasid Shari'ah*-based of performance measurement of Islamic banks named *maqasid* index (MI). Based on Abu Zahrah's theory of *maqasid Shari'ah*, the variables are assigned the weightage using Simple Additive Weighting based on three objectives: educating individuals, establishing justice, and promoting welfare, after the validation of items by the scholars. Their MI was further tested on the six selected banks from various countries. The findings showed that different banks perform highest in each of the seven performance ra-

tios, alternatives, and performance indicators, indicating the inconsistency of the individual Islamic bank's focus on the overall *Shari'ah* objectives. However, the MI does not consider the element of profitability and efficiency that are also imperative to measure the Islamic bank's financial performance.

Mohammed et al. [21] develop *Maqasid* based Performance Evaluation Model (MPEM) using the Al- Ghazali theory of *maqasid Shari'ah* and Ibnu Ashur's reinterpretation. Ibnu Ashur relates the interpretation of *maqasid* with the *masalih* or public interest. Al Ghazali's framework focused on the human being as the subject of *maqasid*, which might not be applicable to an institution such as Islamic banks. Thus, the author adopts Ibnu Ashur s theory of *maqaṣid* for the interpretations and institutional elements that suit the MPEM. Al Ghazali's dimensions of preservation of faith are synchronized with the element of freedom of faith, preservation of life is synchronized with the preservation of human dignity and protection of a human right, preservation of intellect is synchronized with the propagation of scientific thinking and avoidance of brain drain, preservation of progeny is synchronized with the family care, and lastly, preservation of wealth is synchronized with the elements of the well- being of society and minimizing income and wealth disparity, respectively. The appropriate ratios have been assigned to measure all those elements.

The past literature shows that the performance measurement index's development based on *maqasid Shari'ah* is developed following the same qualitative approach [28, 29, 34]. Using this approach first started with the literature review before proceeding with Sekaran's method of operationalization of the dimensions and elements. It is then followed by the finalizing and selecting the variables using the interview process with the expertise and concluded with a validation of the selected variables by focus group discussion. The development performance measurement based on *maqasid Shari'ah* by these studies [28, 29, 34] is still limited and only developed based on Abu Zahrah's and al-Ghazali's five components under necessity. The other two elements of *maqasid Shari'ah*, which are complements and embellishments, are yet explored by the researchers due to the problem of operationalization of the components [28].

Using the similar approach of Mohamed et al. [27], Hudaefi and Noordin [29] and Antonio et al. [30], Tarique et al. [28] proposed a more comprehensive *maqasid Shari'ah* performance index by covering the component of complements and embellishment in their *maqasid Shari'ah*-based performance measurement model for Islamic banks. Previously, Bedoui and Mansour [26] developed a *maqāṣid Shari'ah* based on the Pentagon- shaped scheme performance measurement scale. Their five-pillar Pentagon-shaped *maqasid Shari'ah* performance is based on Al-Ghazali's five cores: faith, intellect, posterity, wealth, and human self. Their Pentagon-shaped *maqasid Shari'ah* performance is more comprehensive because rather than focusing on profit maximization, the scale was developed comprising the objective of promoting and developing human welfare, preventing corruption, and improving social and economic stability.

Adopting the previous work of Mohammed et al. [27], Hudaefi and Noordin [29] enhanced the work of Mohammed et al. [27] by combining both religious and financial aspects in establishing the integrated *maqasid Shari'ah*–based performance measure (IMSPM). The financial performance measurements, which are non- performing loans,

return on assets, return on assets and operational efficiency, are included in the *maqasid Shari'ah* element of wealth.

Concerning the empirical evidence, several studies have tested the *maqasid Shari'ah* performance index. Mohammed and Taib [31] test the PMSS they have initially developed in Mohammed et al. [29] on the sample of 24 banks comprised of Islamic and conventional banks. Interestingly, they also compare those banks' performance with the conventional banking performance measures (CBPM) model, which consists of three ratios: return on assets, net interest income, and liquidity. Their finding shows that Islamic banks' performance supersedes conventional banks using the PMSS model compared to the CBPM model. The authors conclude that the assertion of Islamic banks' performance is left behind its conventional counterparts is not true and it happened because conventional measurement could not capture the objectives of the Islamic banks. This finding indicates that Islamic banks' performance should be measured using the right measurement that suits their nature of the operation and underlying philosophies underlies that is gearing toward the achievement of the *Shari'ah* objective.

Asutay and Harningtyas [32] measure the social performance of the Islamic banking and finance industry according to the three levels: banks, country, and industry level performance. Their study conceptualizes Najjar's view of *maqasid Shari'ah* on the sample of 13 Islamic banks from six countries for five years. Their findings show that Bank Syariah Mandiri and Indonesia score the highest at the bank and country levels even though the overall performance is unexceptional. The industry's orientation puts weightage according to the following self, faith and rights and stakeholding, followed by the wealth and social entity, intellect and posterity, and lastly, ecology. Besides, the findings of Rahman and Haron [33], specifically on the sample of Indonesian banks, based on the adaption of MPEM by Mohammed et al. [21], show that characteristics of the *Shari'ah* Supervisory Board and the structure of board have a significant influence on the maqasid *Shari'ah*-based performance during the period from 2012 to 2016. Consistent with the findings of Asutay and Harningtyas [32], the overall score of the *maqasid Shari'ah* index for Indonesian Islamic banks is still low, and most of the individual Islamic banks show fluctuating value. However, the findings of Antonio et al. [30] also prove that the *Maqasid* Index of Indonesian banks is higher than Islamic banks in Jordan. Using Mohammed et al. [27], Antonio et al. [30] concluded that no specific bank could represent a high index value.

Julia and Kasim [36] apply the *Maqasid Shari'ah* framework of Al-Ghazali in comparing the green performance of Islamic and conventional banks in Bangladesh. Their study found that none of the banks fully meet the green policy requirements. However, Islamic banks perform better in the preservation of faith, intellect, and wealth circulation. Mergaliyev et al. [37] also developed a comprehensive *Maqasid Shari'ah* Evaluation Framework to measure the determinants of Islamic banks' performance in light of *Maqasid Shari'ah*. Adapting the previous works of Bedoui and Mansour [26], Mohammed et al. [27] and Asutay and Harningtyas [32], this unweighted approach index has four primary objectives, which are invigoration the value of human life, human self, society and physical environment. Using the sample of panel data of 33 Islamic banks from nine years periods covering from 2008 to 2016, their findings show that Islamic banks in Jordan scored the highest average of the *maqasid Shari'ah* index, and *maqasid*

Shari'ah is influenced mainly by the political and socio-economic factors. The significance of political and socio-economic factors infers the importance of Islamic banks to adhere to the *Shari'ah* compliance in their activities to protect from deterioration their public image and reputational risk that might jeopardize the financial performance and stability of Islamic banks.

Al Mubarak and Osmani [38] analyze the Islamic banking products against the *maslahah* and *maqasid Shari'ah*. Their finding found that Islamic banking's products based on the *Bai Al-Inah*, *Bai Bithaman Ajil* and *Ijarah* sukuk are against *maqasid Shari'ah* and should be done detailed revision. On the other note, Rahman et al. [39] develop performance measures based on *maqasid Shari'ah* for the halal industry. Alziyadat and Ahmed [40] integrate *maqasid Shari'ah* with the "plan.do.check.and act" (PDCA) cycle in developing a framework to access the ethical aspects of Islamic financial operations. Combining Abu Zahrah and Al Ghazali's framework, Siddiqi et al. [35] formulate stakeholder well-being for the Islamic banking and finance industry. In view of the above literature review, Table 1 summarizes the main literature of the *maqasid Shari'ah*-based performance measurement of Islamic banks highlighted in this paper.

Table 1. A summary on the main literature of *maqasid Shari'ah-based* performance measurement of Islamic banks

Author	Basis	Dimension	Model
Mohammed et al. [27]	Abu Zahrah	• Educating individual • Establishing justice • Public interest	*Maqasid* Indexes (MI)
Mohammed et al. [21]	Al-Ghazali and Ibnu Ashur's interpretation (public interest)	• Necessity element of *Maslahah* • Prevention of religion/faith • Preservation of life/soul • Protection of intellect/mind • Preservation of progeny • Preservation of wealth	*Maqasid* based Performance Evaluation Model (MPEM)
Tarique et al. [28]	Al-Ghazali and Abu Zahrah	• Justice • Education	*Maqasid Shari'ah* based performance measurement model

		• *Maslahah* (Necessity, complements and embellishments)	
Hudaefi and Noordin [29]	Harmonization of the previous works of Khan (1997), Mohamed Ibrahim et al. (2004), Haniffa and Hudaib (2007), Mohammed et al. (2008), Asutay and Harningtyas (2015), Mohammed et al. (2015) and Jaffar and Manarvi (2011)	• Necessity element of *Maslahah*	Integrated *maqasid Shari'ah*–based performance measure (IMSPM)
Mergaliyev et al. [37]	Mohammed et al. (2008), Bedoui and Mansour (2014) and Asutay and Harningtyas (2015)	• Invigoration the value of human life, human self, society and physical environment	*Maqasid Shari'ah* Evaluation Framework

4 Conclusion

The purpose of this study is to review the past literature on the *maqasid Shari'ah*-based performance measurement of Islamic banks. It is found that the study on the *maqasid Shari'ah*-based performance measurement of Islamic banks is still scarce and limited. It can be concluded the previous research refers to the works of Al-Ghazali, Ibnu Ashur and Abu Zahrah in creating the dimension of the *maqasid Shari'ah*. The literature review shows that the work of Mohammed et al. [27] is the pioneer, still relevant, and in

fact becomes the basis of the subsequent empirical research on the *maqasid Shari'ah*-based performance measurement of Islamic banks. The existing empirical research of the *maqasid Shari'ah*-based performance measurement of Islamic banks is also dearth and still has ample room to be explored. However, this study still has limitations in a way that the selection of the studies only comprises the journals and proceedings and exposed to the bias from keywords used in Scopus and Google Scholar features search. This study focuses exclusively on the application of *maqasid Shari'ah*-based performance measurement in Islamic banks and provides insights to the researchers, academicians, practitioners, and regulators and policymakers in reviewing the development of the *maqasid Shari'ah*-based performance measurement of Islamic banks and its pathway of application in the empirical research. It is imperative for Islamic banking's industry players to align Islamic banks' objectives with *maqasid Shari'ah*-based performance measurement, and this paper addresses the literature gaps and serves as a guide for the future research related to this area.

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Internet Banking of Islamic Banks: Issues of Security and Privacy

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Abstract. This paper focuses on problems associated with the usage of internet banking and its privacy and security in the Islamic banks in area of Kota Bharu, a state capital of Kelantan which are attributed to the perspective, decision and suggestions from customers for possible actions that could be taken to overcome the problem. Today the online banking system is one of the services offered by the bank to the customer either by deposit or by the withdrawal of funds. In the ground of privacy security, there are several issues that may lead to the security of e-banking systems. This study is conducted utilizing qualitative methods to ensure the data analyzed through a reliable software package of ATLAS.ti. The data employed were drawn from interviews and documents analysis. Interview's data collected from online banking users in Kota Bharu, Kelantan. The contents and textual analyses also used to achieve this purpose. Researchers concluded that everybody now ends up making online payment transactions by using the technology at their fingertips. Researchers find perception factor to be crucially significant and play a key role in determining whether e-banking adherents are confident and content with the privacy and security of online banking and whether perceptions affect their choice of e-banking. To avoid problems concerning privacy and security, awareness is an essential element. In saving oneself from cybercrime, everybody has their own roles. Trusts also influence decision-making and perception in e-banking access. The implication of this study is that privacy and security are critical aspects in Islamic banking operation, and Islamic banking should take proactive measures to ensure that privacy and security in internet banking are at an optimal level.

Keywords: Internet Banking, Privacy and Security, Islamic Banking, Kota Bharu

1 Introduction

After nearly four decades of existence, Islamic banks have found out how to place themselves as money related organizations which are not only critical in asset assembly, asset distribution, and usage, but are also effectively associated with the path toward actualizing government monetary policy (Narayan & Phan, 2019). In addition to offering practical standard financial institutions, Islamic banks also promote domestic and international trade (Naushad, 2021).

Malaysia's Islamic financial framework is based on a dual or parallel financial system, a structure that enables interest-free and interest-based funding to co-exist for credits and funding (Poon, Chow, Ewers & Ramli, 2020). Furthermore, Poon et. al. (2020) stated that the multi-religious and multi-social features of Malaysia lead to the Islamic financial system's ability to manage conditions in which the demand for and supply of surplus funds are no longer entirely based on confidence, but also on various factors such as return on accessibility, deposits, and the cost of financing (Syarif, 2019). Furthermore, this religious and non-religious essential the showcase segment of Malaysian Islamic banking is accepted in a way that favors in the Malaysian Islamic banking investors' asset report the executive's organization influence execution (Naushad, 2021; Poon et. al., 2021).

Today, internet-based banking systems are one of the services offered by banks as a means for customers when making deposits or withdrawing funds. Computer-generated banks, also known as virtual banks or "branchless banks," are a new term used to describe banks that do not have a physical location, such as a branch, but instead provide services to customers through the internet and ATMs (Al-Shaer, 2021; Sadeghi, 2004).

Customers who use internet-based banking or online banking have direct access to a bank's information system from work, school, home, or any other location where a system association is available. The customer is now regarded as an end-client of the bank's information preparation structure in this contemporary paradigm. The customer's device plays an important role in end-client processing (Jiminez & Diaz, 2019; Gerrard, Cunningham & Devlin, 2006).

Al-Sharafi, Arshah, Herzallah & Abu-Shanab (2018) previously found that their findings affect the behavior of customers to accept online banking services with absolute trust. Furthermore, customer awareness, as well as perceived efficacy, security, and privacy, had a significant impact on their trust. Nevertheless, customers' perceived ease of use did not predict their intention to adopt mobile banking services.

Raza, Umer, Qureshi and Dahri (2020) and Normalini and Ramayah (2017) provide tools to assess the viability of biometric authentication technology in internet banking. While counting user perceptions of the effectiveness of biometrics authentication technologies in the framework's experimental testing, fundamental insights into the dynamics of the relationship between trust and its backgrounds were revealed. The findings of this study, in general, highlight the importance of using biometrics technology in internet banking. The relationships between perceived privacy and security and trust were clearly qualified by the perceived effectiveness of biometrics technology.

Numerous researchers are already conducting research in this field, but the majority of these studies focus exclusively on conventional banking in Malaysia. Researchers rarely pay attention to research on the internet banking system provided by Islamic banking. As a matter of fact, the purpose of this research is to investigate adopters' perceptions of Islamic banks' e-banking in Kota Bharu in contexts of privacy and security. To determine whether adopters' decisions to use e-banking are adversely affected by the potential ramifications of e-banking, and ultimately to determine what measures can be taken to resolve e-banking privacy and security concerns (Raza, et. al., 2020; Yussaivi, Lu, Syarief & Suhartanto, 2021)

2 Literature Review

Islamic banking has become more recognized among market participants during the last decade. This is because technology has improved Islamic banking system performance for better services. In Saudi Arabia mobile services are easily accessible to users according to Alsheik & Bojei (2014). Alongside its expansion, a range of concerns in technology has been recognized. These problems include insufficient technological experience, inadequate use of technology and awareness of the risks involved (Wijayati & Gustyana, 2021).

According to Eklof et. al. (2016), the Islamic banking sector in Pakistan is dominated by shariah compliance understandings, which play a significant role in customer satisfaction. In the Muslim country, both the company's product and services must fulfill Islamic law since it is the most important preference among the customers. Customers will seek out Shariah-compliant institutions to use and purchase their goods and services, as this will provide them with satisfaction in selecting the best institution.

Customers' views are favorably linked to their quality preferences (Wall et. al., 2018). Perception is a common thing that naturally occurs when it is related to humans dealing with something that will result in good or bad outcomes. Especially when the person is about to decide whether to use, apply, or adopt it. It is an active process that requires information processing and then interpreting it into a message to give humans an idea of how individuals perceive something.

Paul et al. (2016) viewed perception of a product's performance will emerge from the comparisons process, wherein the perceived performance of one company is compared to the other perceived performance of another company. Then, with one or more of the other company's standards compared, an expectation will be created. In brief, customers' perceptions of services in the internet banking industry would have a significant impact on the company.

Besides, Mohammadi (2015) found that awareness has an impact on users' perceptions in Iran. On the other hand, Dixit et. al. (2010) analyzed the aspects that have an impact on the use of internet banking services that are surrounded by consumers and show the degree of consideration regarding privacy and security issues in India. Meanwhile, Safeena (2011) observed that awareness of internet banking services was high in their study. As a result, awareness has a significant impact on the adoption of internet banking services and customer satisfaction.

In a study of Aghdaie et. al. (2011), trust can be classified into two types: interpersonal trust and institutional trust. The former is established between online customers and merchants, while the latter is established between the computer and the consumer. The client's assertion that she or he could have relied on electronic banking to ensure the welfare and security of the client's online transactions was referred to as trust (Al-Dmour, Al-Dmour, Brghuti & Al-Dmour, 2021; Holsapple & Sasidharan, 2005).

Riek (2015) demarcated cybercrime as an unavoidable threat in today's Internet-dependent society. Though the true scale and economic impact are difficult to quantify, officials and scientists agree that cybercrime is a massive and growing issue. While according to Gaol, Budiansa, Weniko and Matsuo (2021) and Broadhust (2014), cybercrime is typically defined as a criminal activity involving technologies and computers committed on the internet. Contrary to More et. al. (2016), cybercrime is an intentional attack from one computer to another computer by using network to modify, disrupt, repudiate, degrade, or damage or destroy the data accommodated in the attacked system or network.

2.1 Research Framework

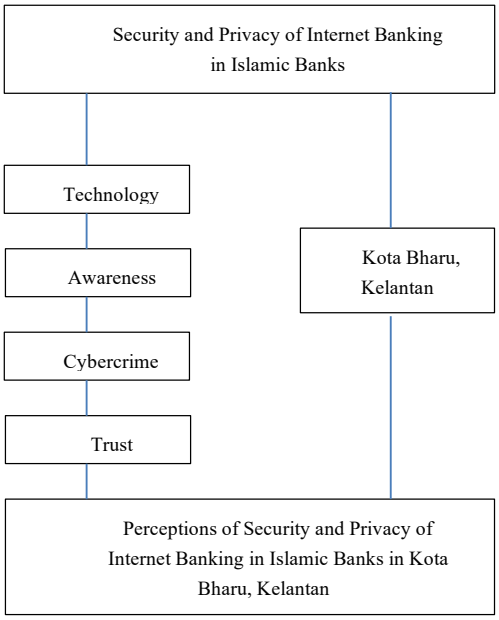

Fig.1. Research framework of perceptions of security and privacy of internet banking in Islamic banks in Kota Bharu, Kelantan

The research framework in Fig. 1 can be defined based on the themes and research gap that have already been identified. According to Fig. 1, the themes identified in the literature review regarding internet banking security and privacy in Islamic Banks are technology, awareness, cybercrime, and trust. Meanwhile, the study was conducted in Kota Bharu, Kelantan. As such, this study will examine customer perceptions of internet banking security and privacy in Islamic banks in Kota Bharu, Kelantan.

3 Method

3.1 Research Design

A research design is a plan that specifies when, where, and how information will be collected and analyzed (Parahoo, 2014). The research design is referred to the framework within which a researcher chooses his or her research methods and techniques (Schoonenboom & Johnson, 2017). The design enables researchers to focus on research methods that are appropriate for the subject matter and to establish a foundation for

success in their studies (Novikov & Novikov, 2019). Since this purpose of this study is to identify adopters' perceptions, analyze customers' decisions in choosing Islamic bank e-banking, and conclude possible actions to overcome privacy and security issues among e-banking users in Kota Bharu, Kelantan, qualitative research is appropriate for this research.

3.2 Qualitative Research

The qualitative method is used to collect data in this study. Aspers and Corte (2019) stated that qualitative research is guided by intense and delayed contact with a "field" or life circumstance. These situations are frequently "cliché" or typical, intelligent of individuals', groups', societies', and organizations' regular day-to-day lives.

Qualitative research is done in the same way as exploratory experiments are done (Crawford, 2006). Likewise, Yilmaz (2013) has expressed a quality research approach to examine people, phenomena, social, cases and processes in their natural state in a natural, naturalistic, inductive and interpretative way to reveal in a descriptive aspect of the relevance of their experience in the globalized era.

The aim of using a qualitative approach in this study was to investigate and portray the perceptions of online banking users in Kota Bharu, Kelantan, on privacy and security in internet banking particularly in Islamic banks. It was an effective method for gathering their thoughts on the effects of internet banking in terms of its privacy and security. The methods used were as follows:

Exploratory Research

Pantano and Vannucci (2019) states that when another area is researched or when little is known about the area of interest exploratory examinations are carried out. It is used to investigate the full concept of the phenomenon and the various factors associated with that too. An interview was used in this study to examine the perceptions of internet banking users in Kota Bahru, Kelantan, on the privacy and security of internet banking. Even though this paper has focused on the privacy and security of internet banking, little is known about the perceptions of online banking users toward Islamic banking in Kelantan.

Descriptive Research

Gupta, Chauhan and Jaiswal (2019) defined descriptive research as a design for providing a picture of the natural environment. It explains the current practice and concludes with the development of theories. According to Creswell and Clark (2017), researchers need to select respondents and research sites purposely in order to conduct a thorough review of a phenomenon. This study aimed to obtain a picture of the perception of

Internet banking users on privacy and internet banking security to improve the security of internet banking. In the context of this study, descriptive research is used.

Interview

According to Willis (2019), a qualitative research interview seeks to cover both accuracy and significance levels, but it is typically increasingly difficult to interview on a meeting level. He explained that the interview on qualitative research looks at the implications of focus topics in the universe of existence of the subjects. The main task of the interview is to understand the importance of what the interviewees say. The purpose of this study is to examine further the privacy and security of internet banking among customers of electronic banking in Kota Bharu, Kelantan.

The respondents for this study consisting of twelves online banking users with a variety of backgrounds. These twelves respondents are taking into account the data saturation as the point when no new information or themes are observed in the data. They came from a variety of backgrounds such as professionals, government servants, university students, managers, retailers and entrepreneurs. This survey inquiries about their familiarity with online banking, how do they know about e-banking, do they know what privacy and security of online banking entails, do they believe online banking is secure and essential in the future, then how does the privacy and security e-banking level of Islamic banks in Kota Bharu affect customers' decision to adopt internet banking.

3.3 Data Collection Method

In this qualitative analysis, data was collected using two methods. Primary data collected through a research survey, which is a personal interview, and secondary data gathered through document analysis of books, journals, conference papers and newspapers.

Primary data

This study was based on primary data collected through a series of qualitative interviews with twelves informants consisting of customers who consistently using internet banking in Islamic banks available in Kota Bharu.

The ordained gave researchers and respondents an insightful discussion to communicate and understand one another. This allowed the researcher to extract relevant data that would have been impossible to obtain through a standardized questionnaire. The personal interviews also allowed the researcher to meet the respondents face - to - face, thus allowing them to evaluate their expression during the talks.

The first source of data is primary data. The original data were collected to answer questions from the research. The researchers themselves are collecting information to test the hypothesis in their study. This file is not available. Then, the data sources are

generally collected via experiments or field research. Interviews and observations are an example. It can be compiled of people, focus groups or expert panels. In principle, the collection of passive and active data is based on two primary methods of data collection (Nguyen, 2019).

The rationale for the interview is to explore the perspectives, meetings, beliefs, or inspiration of individuals on specific issues. Until an interview, informants should be informed about the test points of interest and provide confirmation of moral standards (Devlin & Gray, 2007).

The researcher only chose internet banking customers in Kelantan in this study. The rationale is that the researcher has decided to collect the best and the most numerous replies to complete this research. The researchers have carried out a semi-structural interview as respondents answer the researchers' questions spontaneously. On top of that, researchers also use communication face-to-face to ensure the information is pure.

Secondary Data

Secondary data is information derived from previous studies. These data differ from primary data, in which the investigator collects the data himself or herself from an interview. Secondary data too are reliable in support of every researcher's research. Secondary data also support large-group research, since data from various sources can be collected (Ritchie, 2013).

The information or derivative material gathered by the individual or other researchers. Reviewing a book, journal, conference paper, or newspaper, for example, is an example of secondary data. Journals from databases and academic textbooks such as Emerald, ProQuest, Science Direct, Google Scholar, My Athens, Research Gateway, and Yahoo were used as secondary data in this study.

Secondary data is gathered by the researcher from journals, newspapers, and books. Secondary data is used by researchers to take a data or reference that is related to Islamic banking knowledge. This is due to research indicating that privacy and security are very important in modern digital age.

3.4 Data Analysis Method

To ensure the validity of the information examined in an effective manner, the data collected in the study are analyzed using document analysis and supported by the ATLAS.ti software program. The data for this study gathered using existing resources such as books, articles, and journals. Therefore, ATLAS.ti also was adopted to retrieve data from interviews.

Interview

Interviews are a method that requires subjects and researchers to participate to acquire and collect information. Researchers obtained the information studied directly from direct sources. Any information gathered during the interview must be documented because any responses mentioned by respondents are important data to observe and analyses. According to Willis (2019), the interview method was preferable to the questionnaire method for gathering in-depth data. Interviews can be part of the overall research data collection strategy or one of the techniques used in the study.

Documentation Analysis

Documentation analysis is a type of qualitative research in which the analyst examines documents to identify an appraisal theme. Document analysis is a social research method and an important research tool as it is used in most triangular schemes, which are a combination of methodologies used to study the same phenomenon (Bowen, 2009). Documentation review is a form of secondary data analysis.

Document analysis is used by researchers for a variety of reasons. This is because documentation analysis is one of the most efficient and effective methods of data collection because documents can be handled and obtained from practical sources. When conducting research or experiment, obtaining and analyzing documents is frequently more efficient (Bowen, 2009).

ATLAS.ti version 8 is a powerful workbench for analyzing large amounts of textual, graphical, audio, and video data. Sophisticated tools assist researchers in creatively arranging, reassembling, and managing researcher material. This version 8 maintains the researcher's focus on the material itself. Hence, it meets the needs of researchers for qualitative analysis.

3.5 Validity and Reliability

The concepts of validity and reliability were also used in this study. It is to understand how to minimize the possibility of errors and tendencies by increasing the data's reliability and validity. According to Patton (1994), reliability is one of two factors that qualitative researchers must consider when conducting the study, analysing the results, and evaluating the study's quality. Furthermore, Seale (1999) suggested that creating a good quality study through credibility and validity in qualitative research, as further claimed, “belief of a research report lies in the middle of issues commonly discussed as validity and reliability.”

Conferring to FitzPatrick (2019), validity evolved into a complicated concept. It is more closely related to the conclusion based on the assessment results. That is more

focused on the outcome of the speculation that makes it implied. This evaluating consideration must be accurate and declare the truth. The assessment or evaluation should not be valid; only the assumption about this evaluation should be valid.

4 Findings and Discussion

Based on the findings attained, this study concluded five factors that may stimulate the issue of privacy and security in e-banking are Technology (1), Perception (2), Awareness (3), Trust (4), Cybercrime (5). The findings can be illustrated from network view of ATLAS.ti and the explanation of the findings are as follows:

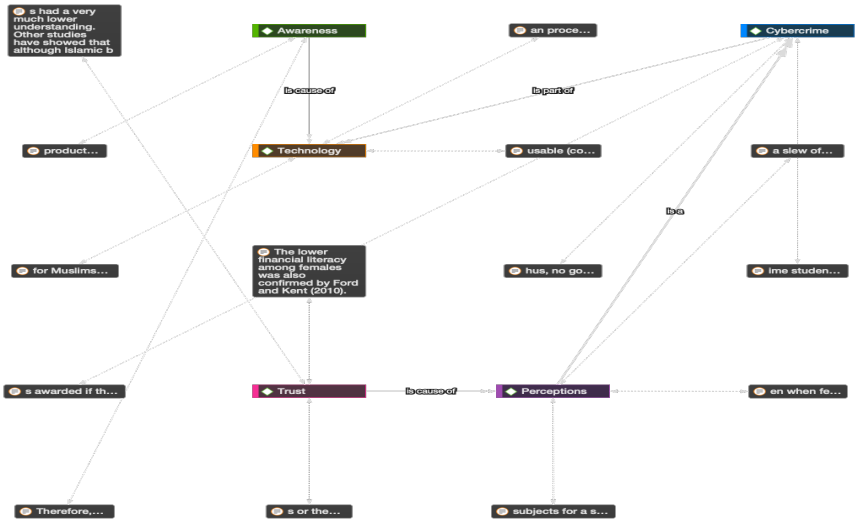

Fig. 2. Network view of perceptions of security and privacy of internet banking in Islamic banks in Kota Bharu, Kelantan

4.1 Technology

Every respondent believed that technology played a significant role in their decision to work in Islamic banking. They acknowledge that Islamic banking, in the absence of technology, will struggle to compete with conventional banking. Additionally, with the advancement of technology in banking, it simplifies banking-related transactions for them.

This view is found to be parallel to Utami and De Guzman (2020). They said that the business process in financial services is incredibly challenging. Banks must introduce alternative delivery channels to attract online users and enhance consumer perception. Most banks have already implemented online banking by providing their customers with a variety of online services that provide greater access to information and transactions. Customers' satisfaction is becoming imperative as a success factor in e-banking. In a service organization, technologies are rapidly being developed. It aims to improve the quality of customer service and delivery while also reducing costs and standardizing core service offerings (Ibrahim et al., 2006).

However, respondents 1, 3, 4, 6, 7, 9 and 12 expressed some concern about whether the technology would also result in concerns about the security and privacy of their banking data. They are concerned about the ease with which irresponsible parties can obtain their personal information. Additionally, the growing problem of scammers heightens their concerns about the security and privacy of online banking. Additionally, banking data hacking incidents have occurred in Malaysia, compounding their concerns.

4.2 Awareness

The majority of respondents stated that they were extremely conscientious about safeguarding personal banking information such as their username, pin number and password. For example, according to respondent 4 stated that:

> *"Along with my credit card and debit card, I did not preserve the password number and pin number in my wallet. This is due to the fact that it is extremely hazardous. In this regard, I will use extreme caution.*
>
> *I will not respond to mails from scammers because I am aware that they are really harmful. They can deceive you in a number of ways."*

Additionally, they are familiar with banking fraud, such as the Macau scammer. This awareness is in line with Tan and Teo (2000) that identify three aspects of consumer behavior that demonstrate consumer awareness of e-banking, as well as subjective norms. Which exemplifies the social impact that can influence the customer's motivations for using Internet banking and, ultimately, recognizing in control of behavior, which explains the anticipation of adapting mobile banking. Awareness is a critical component in preventing problems with privacy and security issues. Both customers and banks must play their roles to stay alert and spreading awareness to the public (Mathiyarasan & Chitra, 2019). Everyone has a role of socially responsible in preventing themselves from becoming a victim of cybercrime.

4.3 Trust

According to Yuusaivi et. al. (2021) and Bhattacharya et al. (1998), researchers from various disciplines have hypothesized trust along various dimensions. Identity analysts usually describe trust as an individual trademark, whereas social therapists generally view trust from the perspective of behavioral desires for others involved in transactions. Economists and sociologists generally focus on how institutions are set up and impetuses are used to reduce vulnerability associated with transactions involving relative outsiders. It has been demonstrated that trust is a critical middle person in all business relationships and should be a central focus of any organization associated with administrations (Al-Dmour et. al., 2021; Morgan & Hunt, 1994). This is parallel to

"Trust plays a significant part in maintaining clients trusting the bank."

Whereas respondent 6 stated that:

"We have no trouble doing business with banks and remaining loyal to them if they can maintain an element of confidence throughout their operations."

4.4 Cybercrime

Cybercrime is commonly defined as a criminal activity involving technology and computers that takes place on the internet. Mogos and Jamail (2021) and Riek et al. (2015) also demonstrated that cybercrime has a significant impact on operational systems in banks. Cybercrime has a wide range of consequences including financial costs and intangible losses. Some cybercrime involves criminals assuming specialized roles and deceiving people. Respondent 2, 6, 9 and 10 stressed that:

"We are particularly worried about recent cybercrime issues, and we propose that the Malaysian government take decisive measures to combat this critical problem. We, as customers, are quite concerned about the current rise in cybercrime."

Whereas respondent 3, 4, 7 and 10 stated that:

"We always take the best precautions to avoid being tricked by cybercriminals; we also propose that the bank take stricter efforts to ensure that customer information is safe and secure; the bank is also required not to sell our information to irresponsible third parties."

In addition, these cybercrime attacks are designed to steal relevant information, money, and other valuable information while leaving no trace of the intrusion (Acharya & Joshi, 2020; Gaol, et. al., 2021).

5 Conclusion

The primary goal of this research is to investigate and investigate adopters' perceptions of Islamic bank e-banking in Kota Bharu in terms of privacy and security. From the findings, it is suggested that there are several factors to take into consideration, and it is the responsibility of banks to ensure that customers are provided with secure systems to use e-banking services, as well as to spread awareness to the customers. Not only that, e-banking users must take personal responsibility to avoid becoming a victim by being aware of and always cautious of any issues or problems related to the privacy and security of the e-banking system.

Users of online banking are acknowledged of the tremendous benefits gained such as convenience, twenty-four-hour availability, time savings, and the ease of conducting transactions anywhere. These are some of the most important advantages of internet banking that users have mentioned. Based on the result attained, privacy and security issues have become a concern to the adopters, not just those who have experienced cybercrime but also those who are not.

According to the study's findings, users are concerned about privacy and security issues, not just those who have experienced cybercrime but also those who have not. As a result, the researcher discovered that perception is very valuable and plays a key role for users who are determined to adopt internet banking. Consequently, their trust and awareness of internet banking, as well as their perception of online banking privacy and security may influence their decision to act. Finally, users of e-banking must be responsible for securing their personal information, and organizations must strengthen their proxy from hackers breaking into operational systems.

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Union 5G
From E-Pandemic Management to the EU's Digital Overhaul

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Abstract. In this paper, global E-Pandemic Management is seen as an opportunity to advance digitalization in the EU (European Union) in all areas, such as E-Education, E-Health, E-Administration, E-Climate Protection, or E-Economy. For a functioning E-Pandemic Management, the digitalization of the affected states, i.e. the process-controlled use of IT (Information Technology) in all areas, is virtually a prerequisite. Therefore, we can also talk about IT-supported pandemic management or IT-supported education instead of talking about E-Pandemic Management or E-Education. We will explain E-Pandemic Management using a directed process for the execution of digitalization projects, which is divided into the sections Motivation, Basics, Modeling, Tool Support, Solution, Usage, and Summary with Outlook. The overarching motto here is that the digital world induces and monitors the analog world. Digitization has the primary effect of making people's lives in the analog world more accurate through process-centric modeling and more secure, because it is now also supported from the digital world by the models (schemas) that have been implemented. However, this holistic approach is only physical possible in the analog world based on a hybrid cloud computing architecture and the 5G mobile communications standard that has already been installed in many places.

Keywords. Pandemic Management · Cloud Computing · Cloud Platform · 5G Standard · Repository System

1 Motivation

On March 11, 2020, the WHO (World Health Organization) declares a worldwide pandemic due to the rapid spread of the Coronavirus. This has the consequence that in almost all countries very far-reaching measures are enforced in the public and private sector, which represent a high restriction of the previously accustomed life [30]. These

measures such as contact restrictions, curfews and quarantine orders, fall under the so-called pandemic and contact management, which are among the most important methods for getting a pandemic under control and restoring normal life [17]. Besides, there are digital or IT-based solutions, such as the Corona Tracing App or the RKI's (Robert Koch-Institute) Data Donation App, which are designed to support Pandemic Management digitally [1, 27]. For optimal pandemic response, all stakeholders should work together efficiently, which in reality looks different. The pandemic represents a worldwide phenomenon - but the handling and management of it are handled in a highly differentiated manner: different political approaches, different process-oriented approaches, as well as different IT-supported approaches, exist [9]. Even at the national level, there is no consensus. There is a lack of uniform digitization and a consistent system that allows all-encompassing networking [28]. This fact poses a real problem for efficient pandemic control and indicates that progress can only be achieved by taking the next step of digitalization. Besides E-Pandemic Management itself, the application domains of E-Education, E-Health and E-Economy are also affected, to which E-Pandemic Management can be subordinated [12]. The goal is to use a hybrid cloud computing-based platform solution to circumvent the problems mentioned and to enable optimized and digital pandemic management from the cloud using interactive application systems. Moreover, it is a generic solution that is not limited to the current pandemic and can be extended and used in the future. Finally, it is also important to note that the development and achievement must be guided by the "language critical EU digitization" guardrails: Process-driven interactive application systems as a contemporary application system type, an integrative architecture to support the analog through the digital world, and language-competent citizens empowered to communicate and cooperate in a language-critical, IT-supported manner, which is made possible by language-based informatics and the existing method of language criticism [21, 22].

2 Basics

For a better understanding and an easier classification of the topic in the overall context, the most necessary basics are briefly conveyed within this chapter. The chapter is divided into the technical (digital world) and expert (analog world) areas. Thus the actual target functionality becomes recognizable: The digital world causes and supervises the analog world via interactive application systems [21, 22]. The digital world follows the laws of formal logic and thus the laws of "being true" according to Frege. While the analog world is based on the laws of nature and empiricism and often also on the laws of "accept true" (belief, opinion, knowledge) [23].

2.1 Expert area

Here, as described, the professionally relevant basics of the analog world are presented.

Pandemic. A pandemic is a disease that, compared to other diseases, spreads very quickly over wide areas, such as countries and continents. In the worst case, a pandemic can lead to the disintegration of the functioning of all public and private structures, to an overload and thus to high death rates among the population. To avoid such proportions, it is essential to develop appropriate planning and preparation for such situations [26, 31].

Pandemic Management. To be able to control a pandemic, sophisticated management is required: the pandemic management. The goal is to ensure the functioning and maintenance of public functions, companies, the structure of society and essential structures in the event of a pandemic or crisis. Overall, well-thought-out pandemic management should be divided into different phases. The behavior between pandemics as well as before, during and after a pandemic must be planned. A particularly important component in this context is contact person management, in which contact persons (those who have come into contact with the disease) are to be managed [14].

E-Pandemic Management. According to Götz, the term E-Pandemic Management is understood to mean an "IT-supported application that performs tasks relating to the preview and planning, organization, management, coordination or control of a pandemic [...]" [12]. At the same time, following Götz, the term is subordinated to E-Economy and E-Education, which in turn are subordinated to E-Health. E-Pandemic Management is thus also the context to be digitized. To achieve the target function the prerequisite is optimal process-centric digitization, i.e. IT use here, in the entire area - E-Pandemic Management, E-Health, E-Education, E-Economy [12].

Stakeholders. Various stakeholders are involved in pandemic management. For a simplified understanding, the following **Fig. 1.** Parties involved in Pandemic Management illustrates their interrelationship. These include the health authorities, which are primarily responsible for contact person management [11], the government, which acts as coordinator and regulator [4], but also the media and social networks play a decisive role in terms of information and knowledge management. Not to be neglected are also the citizens themselves, who have a very great responsibility during a pandemic and must behave within society in a manner appropriate to the situation [8, 13].

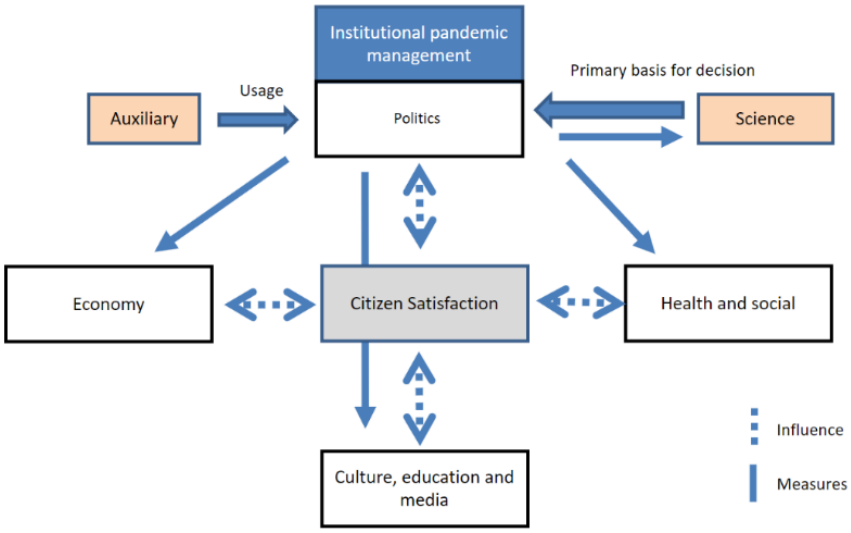

Fig. 1. Parties involved in Pandemic Management

2.2 Technical

Here, the technically relevant basics of the digital world are presented as described.

Cloud. The term "cloud" refers to a potentially worldwide network. A cloud does not represent a physical size, but rather a digital ecosystem consisting of remote servers, which can be distributed all over the world. These make various tasks possible, as is also the case with classic structures: data storage, data management or the provision of services. In principle, the different approaches to the topic of cloud must be mentioned: the public, private, hybrid and community cloud. These types differ mainly in the extent to which persons or institutions can/are allowed to access the services of the respective cloud [3, 18].

Cloud Computing. The term cloud computing refers to this collection of services, applications or resources that are available to all users simply, flexibly and at low cost - in short, a repository. Besides, it is not necessary to have IT expertise to use such offerings. The provider is responsible for operation and maintenance, and the user merely pays a usage fee [25].

Cloud Platform. A cloud platform is nothing more than a Repository System in the cloud, which is a directory of services etc. A user can see which services can be executed via the platform, but not how they work, which is not necessary for principle [3].

5G Standard. The term 5G refers to the latest generation of mobile communications standards, which is establishing itself worldwide as the standard for the mobile Internet - during a great deal of competition (political, technological, ecological, etc.). At the same time the 5G network represents a successor to the existing 4G standard. The advancing expansion of the new standard will enable a wide variety of areas of life to benefit further from digitalization. Since data exchange is faster than with LTE, a much faster exchange of data is being pushed [19, 24].

3 Modeling

The beginnings of modeling can be found in different subfields (e.g. databases and programming) of computer science. Here, the decisive question is about the content, formal and technical meaning of the data. "In this context, data are statements about information objects and their properties based on concepts." [20] In the context of modeling, processes are modeled in this case with BPMN 2.0 diagrams, as directed sequences of an occurrence [23]. Especially since this is possible in different modeling domains. In the context of pandemic management different processes of the overall process were considered for this purpose. It is particularly important to mention that a modeling approach established by Volker Stiehl [29] according to the Process-driven Architecture is chosen at this point: first, the domain-oriented expert-view of processes is modeled (which is done in this chapter). In Chapter 5, the solution, the technically relevant view is then focused on.

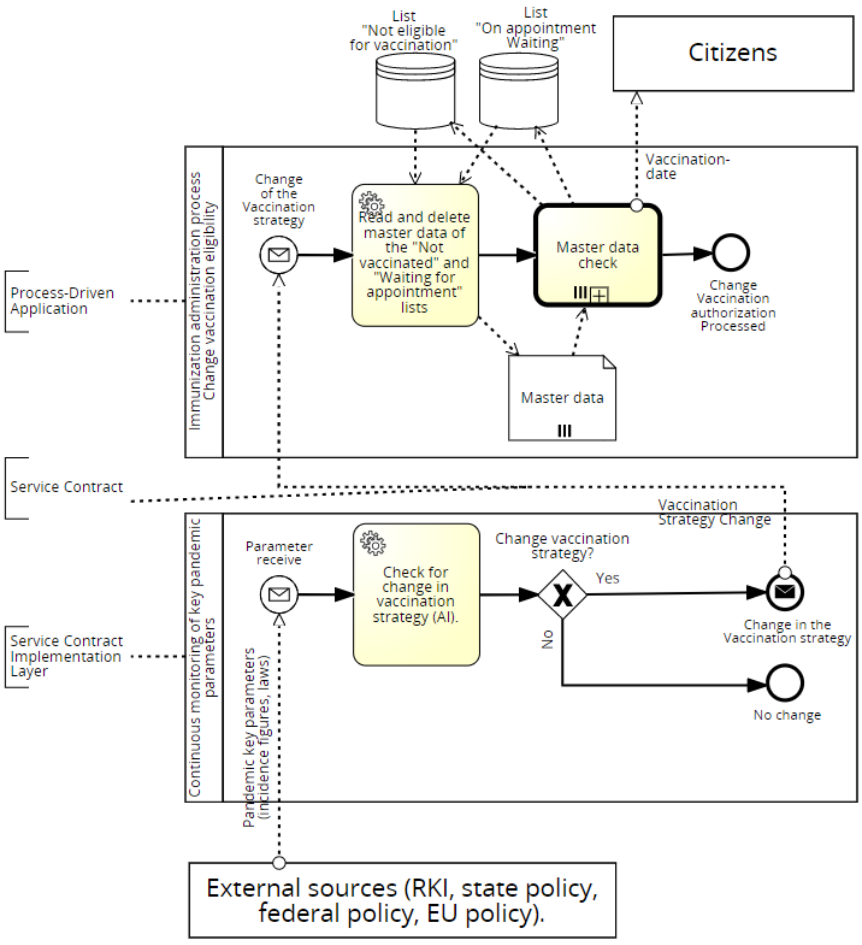

Fig. 2. Business Process of an immunization administration

The upper process (**Fig. 2**) shows the domain-specific business process of an immunization administration. If a change in the vaccination strategy takes place, the citizens managed in two lists (one list for citizens who were not eligible for vaccination according to the old vaccination strategy and a second list with citizens waiting for an appointment) must be checked again for vaccination eligibility according to the new strategy. The verification is performed per citizen according to the new vaccination strategy and, depending on the verification result, results in the dispatch of a vaccination appointment, entry in the list of waiting citizens or in the list of non-vaccination-eligible citizens. To accomplish its task, the process relies on notification of an immunization strategy change, as indicated in the model by the service contract. Through the service contract, process-driven applications express their requirements for services to be provided

externally. How this contract is implemented in concrete terms is not of interest to the process of the process-driven application and is part of the technical implementation of Chapter 5.

Besides, the same approach was followed for the following basic pandemic management processes: Suspicion of contact, suspicion when symptoms are present, data monitoring by the health department and statistical use of anonymous aggregated data.

4 Tool support

By the realization of different analog-digital converters (e.g. first electron tube by Konrad Zuse) the time of computer science begins and finds a provisional end utilizing an optimal software architecture (e.g. the language-stepped multi-purpose architecture, i. A. Gottlob Frege), which was specified and regulates the transition in a contradiction-free way between the analog and digital world, language-logically [23]. The analog-digital converter in technology corresponds to the emotion-speech act converter in humans. What electronic chips are in technology, concepts are in humans [10]. The function of the chips in technology is taken over in humans by the concepts, more precisely: their physical representation, the cells, in the brains. Human-centered symbol manipulation, researched according to Ernst Cassirer [5–7], is the basis for a new language pedagogy that ensures a more understanding interaction of users with information technology (e.g. smartphones, computers). In the future, all further developments should be based on this basic architecture (**Fig. 3**) and interdisciplinary, with the basis of a philosophy of science [15] that is IT-supported, leading to ever newer results in research, which will enter in ever better IT-supported application solutions. These are then mostly interactive application systems that want to satisfy the Turing ideal and at the same time, on the human side, assume free speech acts according to Ernst Cassirer "Animal symbolicum" as the basis of reasoning [5–7]. The multi-purpose architecture mentioned is illustrated in the following **Fig. 3** for the domain of E-Pandemic Management. As mentioned, this architecture can be applied to a wide variety of domains; E-Pandemic Management can easily be replaced by other domains (e.g. E-Climate Management).

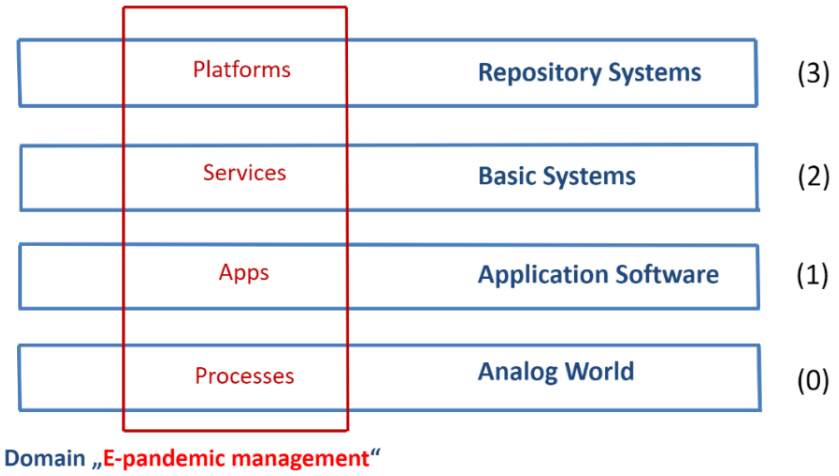

Fig. 3. Integrative General Purpose Architecture [23]

Especially in this context of E-Pandemic Management, different tools are used, which in turn can be classified in the architecture. The chapter is mainly based on cloud computing technology, using the Google Cloud Platform as an example, from which a wide variety of services and technologies are used in this context.

Cloud Computing. To enable a more efficient data flow for pandemic management, it seems sensible to establish a cloud platform that enables and partially takes over the management and processing of the data. In this context, the deployment options (private, public, hybrid, community, etc.) must be considered and used in a targeted manner. In the case of Pandemic Management, a hybrid cloud solution is particularly useful: For example, it may make sense for each office to have its private cloud to organize the administration, but for the offices to be connected to form a community cloud to enable the entire pandemic management between the actors via the cloud. At the same time, the users must also be able to participate in the system, which means that there must also be a public cloud aspect so that appropriate interaction by the citizen can take place. Also, a wide variety of services should be considered, which further leads to increase efficiency. Google offers a total of over a hundred services in various categories, from storage to networking, big data and security [2].

Mobile application based on a user repository. With the help of an interactive application system, which is also based on a repository-supported architecture that is used by citizens, the offices are supported in contact tracking with the help of a digital approach. The focus is on the user and their ability to manage their identity and the data themselves. The user is also offered further opportunities to contribute directly to efficient contact management in a digital way (e.g. in the form of digital diaries that can be automatically forwarded to offices) [12].

Progressive Webapp. A progressive web app also represents one of the mentioned interfaces to the cloud. Especially for the stakeholders such as the health departments, physicians, laboratories and other institutions, it makes sense to use the web interface, since here often also several information from the cloud must be displayed or fed at once. Through this web-based interface, the basic interaction with the cloud platform is made possible for the various user groups [16].

5 Solution

This chapter presents a potential solution approach based on the previous expert modeling and tool support to create a cloud computing-based solution for E-Pandemic Management. The focus is on the implementation using the service contract implementation layer of the process-driven architecture. The solution corresponds to the integrative BPMN schema, which includes the technical layer [29].

The service of notification of a change in vaccination strategy expected in the business process of the process-driven application and described via the service contract must now be implemented in concrete terms, which is why this level (see **Fig. 2**) is referred to as the service contract implementation layer. This layer now takes over the coordination of external information sources and evaluates this information, e.g., using artificial intelligence. If this evaluation results in an urgently required change of strategy, this is indicated via a message to the process-driven application. The service contract implementation layer thus fulfills the required service contract.

As already described in the modeling chapter this step was also carried out for the remaining processes. The digitization of further processes relating to the pandemic will also affect other e-areas. An E-EU can gradually be achieved in this way. As explained at the beginning Corona is a worldwide pandemic, which means that pandemic management is also required worldwide [9, 29]. As in Germany, there are different approaches to this management. This makes it clear that it may make sense to scale the concept developed here further and not just to manage it at the federal or national level, but ultimately to expand it nationally or even internationally. As the following **Fig. 4** shows, the processes at lower levels flow into the processes at higher levels. To approach digitization in a solution-oriented manner the principle of top-down coordination/bottom-up development should be followed [21, 22]. The concept presented should therefore be coordinated from the top, but developed by lower levels and then scaled up. Digitalization based on the cloud platform in particular can open up the possibility of integrating many countries into the system. Since resources and services are used entirely from the cloud, upscaling is possible without any other difficulties.

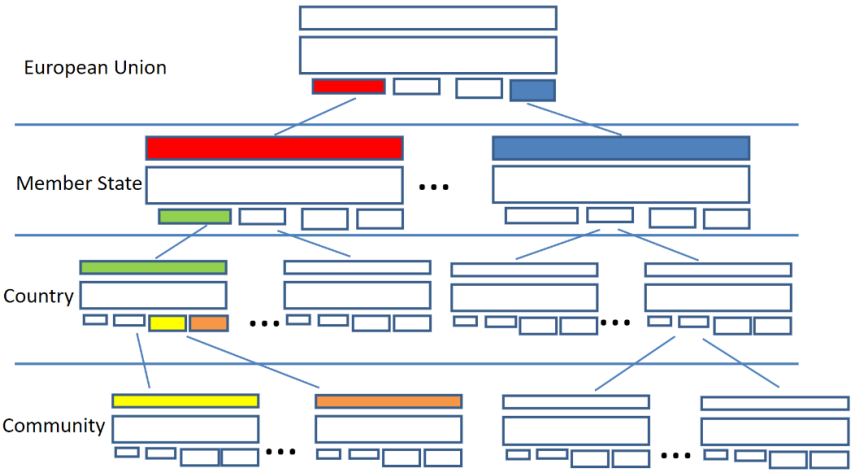

Fig. 4. New EU – through-digitized [14]

Furthermore, the presented approach enables a special degree of user-orientation. Since in the foreseeable future humans (regardless of their age or IQ (Intelligence Quotient)) will in all likelihood no longer forget anything crucial and will always be provided with the highest quality knowledge for making decisions or performing actions, regardless of when or where they need it, an adequate tool is also required here. Thus, an approach is delivered with which people can manage their schemata and their knowledge better and convert them into actions [23].

6 Usage

Especially in the 21st century, data represent a huge potential and can even be considered the "oil of the century". However, it is important here that schemes for interpreting this "raw material" - knowledge and information management thus play an important role [23]. It is often the case that we cannot do anything with the knowledge we have and it is difficult to distinguish whether we believe, mean or know something. Just the use of knowledge must be coordinated by appropriate management concerning the use in a community for the achievement of progress. At the current time, we have a wide variety of apps and services available to support us in this (e.g. Blinkist or Wikipedia). The goal must be to constantly adapt the schemata of our reality orientation - dialogically if possible - to changing circumstances. Ideally, this adaptation should be co-acted by different scientific disciplines, since schemata only represent the language-logical supports in an analogous world. Through this background also the use in this context and its data should be represented. For decades, the function of information and knowledge management has been assumed by so-called Chief Information Officers in companies and the state.

7 Summary with outlook

The concept of cloud computing supported pandemic management described in this paper has the potential to address the problems mentioned at the beginning and enable more efficient management of pandemics that require contact tracking. A language-critical digitization and education of users to use languages in a disciplined manner as a condition emerges, bring all the components described closer together. With renewed reference to the guardrails of EU digitization, the educational level of the population and its language competence is supported by technology. In this context, digitization represents the logic-based part of enlightenment. At the same time a multi-purpose software architecture between the digital world (cloud computing) and the analog world processes has to be built and interactive application systems developed according to the Volker-Stiehl method have to be established. The digital world thus supports the described things and events from the analog world using the formal-logical laws. Digitization in itself thus means the education of people from the analog world to a disciplined use of language. On the hardware technology side, the focus is also on the 5G standard. The resulting networking of all participants thus represents an essential added value. In addition to illustrating an efficient solution for E-Pandemic Management, the concept can also be seen as a critique of current inefficient and non-digital attempts at pandemic management. The applied digitization step can create a central cloud-based platform that can be flexibly and easily extended by different modules and features depending on the use case. Nevertheless, it must be noted at this point that the system developed here is to some extent dependent on how willing the user is per se to release his data in the first place. Since the current Corona pandemic is a worldwide problem, there is an international and worldwide case for top-down coordination and bottom-up expansion or development of this concept. However, this will require appropriate centers to take up the coordination of such large-scale digitization projects in the future. In the future, there is also the possibility of expanding the concept and applying it to other phenomena - e.g. E-Climate protection or the E-Economy. Using an actual implementation of this concept, it will be achieved that the digital world is connected to the analog world via interactive application systems and the "educated citizen" and that a language-driven digitization and education of users to a disciplined use of language can take place.

Finally, it should be noted that for the successful implementation of such a concept a suitable infrastructure must be in place concerning cloud computing and the 5G mobile network - neither of which is yet the case in Germany. This also applies to digitization, applications and E-Education for the population. All of these areas still leave a lot of room for improvement compared with countries such as Israel. The motto now is: see how things are and do better than dictatorial states.

8 Glossary

E. The acronym "E" (e.g. in E-Pandemic Management) is derived from "electronic data processing" (EDP) and is used in the sense of "EDP-supported". A synonymous term

would also be "information technology-supported" or "IT-supported pandemic management."

Interactive Application System. Any information technology (IT)-associated object - to the extent that it is in the use of (language-enabled) humans or their actions - is an interactive application system, and its intercommunicating functioning depends critically on language mastery - on the part of both humans and technology.

Repository. A repository (plural: repositories) is a self-managing directory for storing and describing digital objects for a digital archive (e.g., database, program library). The described objects are usually not stored in the repositories.

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From Managing Diversity to Managing Opportunity

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Abstract. Companies with path-dependencies on trivial assumptions reach their limits in Society 5.0. Resilient and vital organizations need multiple reservoirs of competencies, i.e .their people's capabilities. Furthermore, resilient organizations in hypermodernity depend on an ability to respond to rising complexity by enhancing their own inner variety and competencies. Society 5.0 is characterized by a huge amount of diversity, and is human-focused. This paper presents a human-centered approach, the Capability Approach, which is conceptualized as a developed approach to Diversity Management. This paper goes beyond the classical diversity discourse, outlining an approach to Managing Opportunities in Society 5.0 that contributes toward the SDGs and Capability Management, introducing the Capability Cycle as a process for managing opportunities for dialogue-orientated communication. An economy designed for people requires a new diversity discourse − because the right to development is an inalienable human right.

Keywords: Diversity, Economy for People, Capabilities, Opportunities.

1 Human Diversity in a complex world

Considering the actual social, political, institutional and technical changes as well as tensions affecting Western economies, the salient issues facing Germany include a shortage of skilled workers, migration and demographic change. The digital transformation is affecting the labour market, entailing further issues around the future-focused reimagining and re-designing of work. Technological advancement and the New Economy shift have impacted social values, thus workplaces, preferences and roles are changing. The German Federal Ministry of Labour and Social Affairs [6] utilises the term „work 4.0" to designate these developments.

The German economy is a special case in that its driving force is its powerful segment of small and medium-sized enterprises (SMEs) which represents the engine of the German economy. The resilience of the economy and its management in the interest optimal prospects depend on innovative development work by key actors and creative employees. Around 99 per cent of companies in Germany are SMEs [13], thus their great significance and powerful role in the economy is evident. A study conducted in [18] drew major attention to regional development by innovative promoters with regard to technology, tolerance and talent.

According to Jacobs [21] and Glaeser [17], talent is what stimulates economic development and innovation. Vibrant human creativity and diversity can become a driving force for the economy and society. In practice however, rural and regiopolitan areas are suffering from brain drain. Demographic changes are revealing future challenges including labour shortages. According to an OECD [27] survey, nearly 90 percent of SMEs report shortages in the mid-level skilled labour while 65 percent are lacking highly skilled personnel. Both these figures are set to increase, exacerbating the challenges of retaining highly skilled staff and recruiting qualified individuals.

Generally, Western economies are experiencing rising contingency are subject to substantial uncertainty and are characterised by a dynamic complexity. A transformation amounting to the next industrial revolution is affecting companies, society and individuals as digitalisation inaugurates a new era of work in which much human labour will be replaced by algorithms. The aim behind efforts to develop resilient systems is to enhance choice and skills among the population [32]. Several studies have investigated inequalities in the labour market which accelerate brain drain in rural areas. Inequalities result from lacking economic, social and cultural participation by swathes of the population. Social discrimination plays a large role in relation to available skill levels in labour markets. Unequal employment opportunity and other labour market disadvantages translate into a capability gap for businesses.

The further chapters of the paper are: The Path of Diversity Management, that is followed by the chapter Managing Opportunity and finally ends with the conclusion.

2 The Path of Diversity Management

Discrimination is more than making distinction, representing a complex process of exclusion. The term is generally associated with unequal treatment or disadvantagement. Understood as an influencing on how social norms and codes are defined, discrimination can be seen as a definitory power within a social system. Discrimination has tremendous negative impact on skill acquisition within society, reducing opportunity and participation in social and business life. Germany's political response around protecting employees against discrimination has included the General Equal Treatment Act (AGG), introduced in 2006. The ultimate cost of discrimination for society remains unmeasured. Public and private-sector organisations are responding to the problem of discrimination via Diversity Management as part of their CSR strategy, which is now a widely popular practice aimed at exposing and reducing disadvantagement within organizations [28]. Diversity is defined by a set of six core characteristics addressed under §1 of the German Equal Treatment Act: ethnicity, gender, religion, physical disability, age and sexual orientation. Conventional diversity approaches are sharply focused on highlighting differences of human diversity so as to move away from one-dimensional attribution of identity and stereotyping in discourse in favour of a more nuanced, multidimensional view. Diversity is viewed as consisting conceptually of four areas [19]: personality (e.g. traits, skills), internal factors (e.g. gender, race, ethnicity), external factors (e.g. nationality) and organisational factors (e.g. position). Diversity awareness

is historically rooted in the social unrest of the 1950s in the United States [9]. As US corporations increasingly expanded overseas, the notion was imported into Germany via subsidiaries starting in the mid- 1990s. Over the years, three approaches have emerged as central concepts for diversity management [34]: fairness, access and legitimacy, learning and effectiveness.

The first and second of these approaches concern adapting organizations to changing environments while disregarding the management view and internal integration. The third approach concerns the internal management of diversity

Regarding the positioning of Diversity Management (DM) as an element of change processes within organizations, various approaches have been discussed in management and organizational theory literature, including Morgan [25]. Bolmann and Deal [8] reframe the organization with a focus on four distinctive frames: structural (focusing on goals, effectiveness and task), human resources (behavior and action), political (power, conflicts, influence) and symbolic or cultural (social interactions and symbols). In the political frame, the question of power and its distribution within organizations is of interest here, which is neglected in most DM literature. Purtschert [29], in another critical perspective on Diversity Management, states that instead of considering social justice, Diversity Management is much more focused on maximizing profit, thus being reduced mainly to economic efficiency variables.

3 Managing Opportunity

3.1 The Human-Centred Capability Approach

Society 5.0 is a concept aimed at the realization of a human-centered and creative society. It is important however to first have to examine the vision of a human-centred economy through the lens of the Capability Approach. The Capability Approach (CA) defined by Sen [33] and Nussbaum [26] is a multidimensional concept that addresses the economy of human well-being [31, 32]. It represents a critical response to the neoclassical approach, thus restoring ethical, moral and solidarity dimensions to the discussion of vital economic problems

Sen's interpretation [33] focuses on the 'doings' and 'beings' that people can achieve. These are referred to as 'functionings'. The capability set of one person is constituted by vectors of potential functionings which are available to choose from. Capability is bound up with opportunity and freedom, freedom requiring real opportunities [33]. The functionings achieved depend on the capabilities or opportunities that people have in order to reach the valued goal (capability set), which is in turn affected by conversion factors and available resources [33]. Conversion factors have a high impact on capabilities, as they allow people – if they desire- to turn capabilities into functionings. However, there are different types of conversion factors, as discussed in the literature. Deneulin and Stewart [14] outline the significance regarding the forming of capabilities of the structures of living together that define the properties of society, exploring how these are organized in terms of social norms, cultural practices and trust.

The most discussed conversion factors follow Robeyns' model [30], which recognises three groups of personal, social and environmental conversion factors. The individual or personal factors are internal to people, such as age, gender, ethnicity, talents and disabilities. Collective or social factors are aspects affected by the social environment of the individual (e.g. social and legal norms, discriminatory practices, power structures, societal hierarchies, an public policies respecting gender or ethnic discrimination. Environmental factors are external, including climate, geography, institutional resources and workfare policies. These factors are of major importance regarding the development of capabilities. All conversion factors have impact on beings and doings, and thus are relevant to freedom and the choice to convert resources into functionings.

The Approach emphasizes real freedom of choice and individual heterogeneity [22]. Well-being is viewed as relating to the freedom to live a life which the individual values [1]. The Capability Approach has been applied in various fields, though chiefly in regard to human development, inequality and poverty.

In respect of the intersectional theory [10] of multiple deprivation and disadvantagement, human diversity in this work is kept consciously open. Intersectional theory concerns the multi-dimensionality and interrelatedness of plural forms of discrimination and identities. "Human diversity is no secondary complication (to be ignored, or to be introduced 'later on'); it is a fundamental aspect of our interest in equality" [33]. Human diversity is thus a primary consideration in the Capability Approach. Other normative theories recognize human diversity to a very limit extent.

Viewed through the lens of the Capability Approach, inequalities, power concentration, social discrimination and the reduction of diversity into singular affiliations generate deprivation of opportunities, freedom and development [31]. A capability gap results from lacking opportunity, meaning there is an imbalance between rights and opportunities and the ability to exercise and take advantage of these [20]. Ballet et al. [3] point out that differences in opportunity are associated with power inequality between different groups, explaining these problems as differences in power rather than culture. This reveals the great importance and impact of conversion factors in the social environment (context). The Capability Approach is a recognised concept in development economics with relevance to intersectional inequality.

3.2 The Process of Managing Opportunity

Sen and Nussbaum acknowledge empowerment in the context of human development, indirectly recognising two forms of empowerment within the Capability Approach: agency and expansion of the capability set. This paper looks at managing opportunity in the context of companies and business management, discussing how companies that tend to focus on cultivating staff potential represent promoters of agency in carrying empowerment and capability forward. Empowering people by enhancing their well-being and agency increases opportunity for greater achievement.

Developing human potential and capability is the task of managers and leaders, who are called upon to create supportive conditions and frameworks within the organisational context. Companies are subject to dynamic complexity, representing turbulent systems which can be seen as organically self-organising. In this context, monocultural

companies are past-oriented, too rigid and less able to learn from experience and adapt accordingly, due to lacking creativity and innovation.

Ashby's law, also known as Law of Requisite Variety, states that: "The larger the variety of actions available to a control system, the larger the variety of perturbations it is able to compensate" − which creates challenges for management [24]. According to Lewin [23], organizations can only be changed if their people change. And organisational change is a process, even as all change represents a learning process.

This explorative literature paper is theoretical and interdisciplinary. The research goal is to flesh out the classical Diversity Management approach in relation to the Capability Approach. It thus links the Capability Approach with the systemic-relational approach of organizational development, tying in with new perspectives on managing diversity in organisations. The study defines diversity as multiple competencies which represent problem-solving skills [4]. Managing diversity in organisations is therefore a matter of managing capabilities [28].

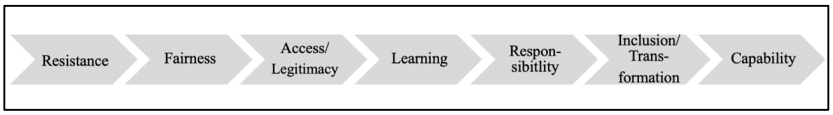

Fig. 1. Paradigms of Diversity Management [28]

With regards to the research lack of identifying capabilities in business cases, this paper presents a methodology for developing capabilities in organisations consisting of three primary steps: Diagnosis, Implementation and Reflection.

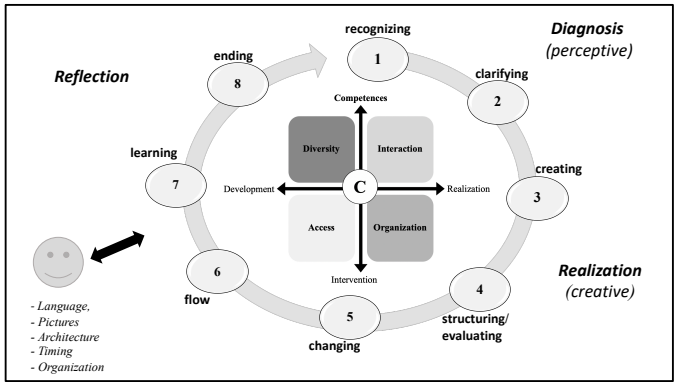

Fig. 2. The Capability Cycle [28]

This method, called the Capability Cycle, is a systemic-relational process of enabling capabilities, change and learning [28]. As is it a context-sensitive approach, it helps create a development-friendly context. The method recognises four levels within business organizations for defining capabilities (C): diversity (field of competencies, development area), social interaction (realisation options), organizational structure and

access to resources (intervention options), These four main areas have to be taken into account in the three primary steps of the cycle (Özdemir, 2019) in an iterative communicative interaction process consisting of eight stages: (1) recognizing, (2) clarifying, (3) creating, (4) structuring/evaluating, (5) changing, (6) flow, (7) learning and (8) ending (Bergmann 2014).

Every interaction begins with special occasions or a welcoming speech. The first steps involve defining a common ground, starting with the recognising of team members and relevant participants and followed by arriving at a mutually accepted description of the problem, then by arrangements regarding the issues. Members of the same team will have different backgrounds and have enjoyed differing opportunities. The manager has to place great emphasis on soliciting different views proceeding from the diverse socio-demographic characteristics of his/her team members. This helps generate a great deal of commitment in support of the project.

Arriving at a shared perspective around the task at hand becomes possible by jointly clarifying the context and working out commonly acknowledge rules. The second step is diagnosis, i.e. constitution of a common ground for agreement on mutual goals, competencies, visions and problems. Visions and guidelines facilitate identification, orientation and development. Erpenbeck and Heyse define competence as the capacity or ability to self-organise [15]. Competencies can be described as problem-solving skills.

Step three is about creating opportunity, solutions and differences. Creativity can often be promoted via 'abduction', such as in and through free zones that force team members to dissociate from the problem. Other well-known creativity methods include usability, brainstorming, mind mapping, brainwriting, method 635 and morphological boxes. After developing forward-looking ideas, team members then evaluate and plan possible solutions together to eventually arrive at joint decisions.

To realize a change in step five, one can intervene in the context, actors or institution. This in turn is possible by changing 1. language/images (e.g. concerned and respectful interaction, positive expressions by changing words), 2. design/architecture (e.g. pleasant working atmosphere), 3. organizational structures (e.g. flat hierarchies) and 4. time management (e.g., idle time, flexible working hours) [24]. Project members are invited to report and evaluate results and voice praise or criticism in the next stage. In the best-case scenario, participation and common decisions allow experiencing a flow which then in stage seven yields patterns for reflecting and learning. The project concludes with all participants providing feedback on their experiences.

Team organization is founded on the motivation of the members by decentralized and participatory nature promoting success. The main tasks of the manager or facilitator are to provide new ideas and provoke thought create a framework of interactively developed standards and goals and fostering a fearless atmosphere that gently supports vitality and overall development. This creates a favourable environment for cultivation of a shared culture and a conducive atmosphere for dialogue, communication, engagement and lasting relationships [7]. According to Ferrucci [16], only the kindest will survive. People in flow are friendlier, happier, more cooperative and more generous [11.]

This management approach makes possible the integration of heterogeneity into organizations. The manager plays a highly important role in shaping the change process

as the leader in forging and maintaining relationships with other actors, and in relation to the environment, products and other considerations. Managing means creating and forming the context by intervening in (a) language, images, culture, (b) time, (c) organisation and rules, (d) rooms and spaces and (e) people [4].

4 Conclusion

Conventional diversity discourse is sharply focused on highlighting elements of human diversity around a one-dimensional attribution of identity and stereotyping, at pains to point out that differences matter and how discrimination and exclusion take place on various levels. Beyond conventional discourse however, as in this paper, diversity management is looked at in terms of managing capability. The task of identifying capabilities for business cases is thus contextualized.

Enhancing capabilities requires a development-friendly management framework such as that introduced by the Capability Cycle − a relationship and context management process. While changing people as such is not possible, the framework and working conditions in which they function, i.e. the institutional and organisational context, can be influenced. Changing the framework or context effects behavioural changes that influence people and their relationships. This paper argues that differences between human beings should not form a basis for discriminatory practices, and that developing employee potential and promoting capabilities and opportunities should be the primary goals in view of the unchangeable traits of human beings (e.g. gender, ethnicity). For this is necessary to alter power dynamics in companies and social environments.

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Representing SME Creditworthiness in Society 5.0

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Abstract. Society 5.0 envision a human-centered society that balances economic advancement and the resolution of social problems by a system that highly integrates cyberspace and physical space. This exploratory paper focuses on SME limited access to credit. Access to financing is a significant social issue for society in eradicating poverty and achieving economic equality. Despite their significant contribution, credit constraints hinder SME's growth and development. We present our argument that conventional financial institution representation on SME creditworthiness may not be sufficient to mitigate the information asymmetry issue in serving the SME lending market. This exploratory paper investigates the challenges in representing SME creditworthiness and proposed a solution to mitigate the issue. Society 5.0 agenda presents an opportunity to reengineer creditworthiness representation because of newly available technology in collecting, analyzing and sharing data. Since the process requires an intelligent agent to interact with the accumulated knowledge for reasoning and decision-making purposes, a knowledge representation of SME creditworthiness is necessary to achieve the agenda.

Keywords: SME, Creditworthiness, Knowledge Representation.

1 Introduction

Access to financing is one of the significant social issues that become a constraint to society. Leaders are designing agendas and strategies to reduce economic and financial disparities with the financial inclusion initiative [1]. Financial inclusion is a significant building block for poverty reduction and economic growth. The ultimate goal is to improve the overall quality of the societies lives by allowing them to use financial services [2]. One of the significant debates on financial inclusion is SME access to financing. The financial inclusion market presents an enormous opportunity potentially from banking underbanked SMEs [3].

SMEs will open economic opportunities worth USD12 trillion and create 380 million jobs by 2030, with more than 50 per cent of the opportunity located in developing countries [4]. The SME spectrum plays a prominent role in social-economic development. The sector contributes to national income, employment, productivity, support large enterprises and encourage entrepreneurship [5]. Despite their significant importance, access to financing remains a primary constraint for SME development in

developed and emerging economies. The sector requires access to financing for their creation, survival and growth [6].

Society 5.0 envision an ideal form of the future 'super-smart society' through a high degree of merging between cyberspace and physical space and leveraging ICT. The concept necessitates a balance of economic advancement and the resolution of social problems. The usage of IR4.0 technology will perform a role as an agent that supports the smart-society, thereby optimizing the entire social and organizational system [7]. Society 5.0 will feature an iterative cycle in which data are gathered from the real-world, analyzed in cyberspace, and converted into meaningful information to derive real-world solutions for managing or improving society. The cycle emphasis on knowledge accumulation and sharing on a societal level to allow continuous improvement [8].

Society 5.0 present an opportunity to achieve balanced economic development and resolve the social issue, mainly around poverty and economic inequality. Therefore, SME limited access to financing is a significant issue that needs to be solved. We present our argument that conventional financial institution representation on SME creditworthiness may not be sufficient to mitigate the information asymmetry issue in serving the SME lending market. This exploratory paper explores the issue of representing SME creditworthiness and proposed a solution according to Society 5.0 recommendation.

This paper is organized into six different sections. In section 2, the paper explores the fundamental problem of lending and factors contributing to the information asymmetry in serving SME borrower. Section 3 discusses the methodology applied to conceptualize the solution to solve the issue according to Society 5.0 vision. Section 4 provides a recommendation on formulating a knowledge representation of SME creditworthiness to mitigate the information asymmetry issue. Section 5 discuss the general characteristics expected of the knowledge representation of SME creditworthiness. Finally, the last section summarizes the exploratory paper and discusses future research and limitation.

2 Literature Background

In this section, the discussion begins by exploring literature about SME borrower characteristic, the concept of creditworthiness and the impact of information asymmetry in lending. The literature provides an overview of the lending phenomena in serving underserved borrower.

2.1 SME Access to Financing

SME faces structural challenges due to information asymmetries, and the sector is deemed to be lacking in financial skills and knowledge [6]. Lending business to SME risky even if default probabilities are heterogeneous across maturities, regions and risk levels. SMEs poor-credit assessment, lack of collateral, incomplete documentation and lack of credit history have made the banks reluctant to lend. Fluctuation in income or

earnings volatility causes high uncertainty on returns and has severe implication on SME credit quality [9].

High uncertainty and vague credit status have prompted the bank to credit ration the sector to reduce the potential risk of credit losses. Credit rationing has become a bottleneck that restricts SME growth and development [10]. The opaqueness of the firms makes it very difficult for SME to obtain formal credit. The banks require transparent information regarding the financial health of the firm. The majority of the SMEs do not maintain decent financial statements of their transactions and operate in an opaque manner. Therefore, the banks and financial institutions hesitate to provide credit to SMEs because of information asymmetry that leads to adverse selection and moral hazard issues [11].

The foundation of the decision-making processes on lending depends on economic data. SME limited data contribute to the information asymmetry problem [12], results in higher risk and discourages bank lending [13]. Opacity and uncertainty of SMEs characteristic have led to unfavorable creditworthiness value. Conventional banking requirement for formal credit could not fit the underserved SME borrower. The literature supports our argument that the bank representation on SME creditworthiness is not sufficient to mitigate information asymmetry in this risky segment.

2.2 Information Asymmetry Impact on Creditworthiness

The money lending business will always be affected by credit risk. There will be an element of uncertainty in credit transaction that poses a form of risk to the lenders [14]. Credit risk is a financial risk when the creditor faces losses because the borrower does not repay their debt obligations [15]. Therefore, an important aspect of the lending business is credit evaluation to determine repayment probabilities. Borrower's creditworthiness provides the basis for the lending decision and the pricing and structuring of the loan agreement [16].

The ultimate purpose of credit analysis is to assess the borrower creditworthiness. [17] provide an interpretation of creditworthiness as the "*economic and legal capacity of the borrower to obtain a loan and return it to the commercial bank following the terms and conditions of the agreement*". [18] indicate creditworthiness must take into account the borrower's ability to receive, efficiently using, and repaying credit. The concept of creditworthiness is significant in lending and remain the underlying factor that represents a worthy borrower. Empirical evidence suggests creditworthiness has a significant positive influence on access to finance [19].

Before receiving credit, a borrower needs a reputable credit rating. Conventional lenders want the most creditworthy borrowers to protect themselves from default risk. Information asymmetry is a form of information disconnect that affect the credit evaluation process. Information asymmetry is a concept about two transacting parties, with one party always knowing more information than the other [20]. In a perfect market theory, complete and costless information is available to both parties and no uncertainties regarding present and future trading conditions. The parties do not suffer from market failure due to the completeness of the information. However, in the real world, information is neither perfect nor costless. Thus, information asymmetry is an acute issue

in small businesses financing because of high risk and uncertainty regarding future conditions [21].

Efficient markets require a mechanism to overcoming the imperfect information problem. Financial intermediaries exist to overcome market failure and resolve the information asymmetry problem. Distortion of information in credit allocation will lead to adverse selection and moral hazard problems. Adverse selection increases the probability of a loan being disbursed to borrowers with bad credit risks. Moral hazard lowers the probability of loan repayment [22]. Information asymmetry distorts borrower's creditworthiness information and the issue is more significant when it comes to SME borrower because of their characteristics.

Improving the scale and efficiency of SMEs finance requires financial innovation to improve enterprise credit systems, and promote better capital management for SMEs [23]. Therefore, the literature supports our argument that information asymmetry reduces lending market efficiency and is causing all credit rationing behaviour on SME borrower.

3 Methodology

How to represent SME creditworthiness in Society 5.0? is a fitting research question to explore the new conceptualization. This exploratory paper will utilize the integrative review to address the new emerging topics. The method provides an overview of the knowledge base, critically review and potentially reconceptualize, and expand on the theoretical foundation of the specific topic. The methodology is suitable to create initial or preliminary conceptualizations on a new topic. The review requires a more creative collection of data. The purpose is usually not to cover all articles ever published on the topic but rather to combine perspectives and insights from different fields of research traditions [45].

Although an integrative review can be conducted in many ways, researchers are still expected to follow accepted conventions for reporting on how the study was conducted [46]. Therefore, the paper explores literature to understand the concept of Society 5.0 visions to achieve economic advancement and the resolution of social problems. This paper conceptualizes the solution through knowledge representation to achieve AI and provide initial characteristics of the knowledge representation.

4 Knowledge Representation of SME Creditworthiness

Financial institution and banks require an optimal functioning credit mechanism based on the timely repayment of borrowed resources. Therefore, distributing a loan to a worthy borrower based on the credit rating approach was applied. The rating provides a general idea about the borrower and the quality of the loan portfolio. The rating approach is valuable because it requires a constant collection of updated information [17]. The purpose of credit scoring is to provide a concise and objective measure of a borrower's creditworthiness. The credit scoring system provides a firm basis for the lending decision and enhances time efficiencies making decisions [24].

Formulation of credit score or credit rating utilizes a various type of determinants. Information or data is fed into an assessment model, and the result represents the borrower creditworthiness. Lack of public information, inadequate quality and frequency of financial statements compared to large enterprises makes it difficult to assess and monitor SMEs credit risk [25]. [26] indicate managing credit risk for SMEs requires models and procedures specifically designed for SME. The conventional creditworthiness assessment model may not fit the sector.

Credit score or credit rating is the underlying borrower creditworthiness information. A finite number of determinants is applied and processed to generate a credit score. The term determinant is defined as a factor that collectively and decisively influences the probability of default or risk level of a borrower. Society 5.0 agenda on the advanced fusion of cyberspace and physical space presents an opportunity to reengineer creditworthiness representation because of new technology available in collecting, analyzing and sharing data. The process requires an intelligent agent to interact with the accumulated knowledge for reasoning and decision-making purposes. Therefore, a knowledge representation is required to represent SME creditworthiness.

Knowledge representation is a symbol used to represent propositions, built on knowledge or information. Modern computer applications use knowledge representations in various contexts, including information search, simulation, web semantic ontology description [27]. Knowledge has become the main value driver for modern organizations and a critical competitive asset. A successful knowledge representation provides a means for expressing knowledge and facilitates the inference processes in human and machines [28].

[29] elaborate knowledge representation is about understanding and describing the richness of the world, which carries five distinct roles. The function of knowledge representation act as a surrogate inside a reasoner for the things that exist in the world. It is also a set of ontological commitment that represents an approximation to reality, highlighting a specific part of the world. The focusing effect is essential because the complexity of the natural world is overwhelming. The third role for representation is as a fragmentary theory of intelligent reasoning that typically motivated by some insight indicating how people reason intelligently. Based on the pure mechanistic view, representation is a medium for efficient computation and inevitably central to the notion of representation. Finally, it is also a medium of human expression to express the world.

The goal of the representation system is common sense reasoning. There are four underlying properties to ensure a desirable representation system. The system must show representational adequacy to represent the required knowledge and inferential adequacy to manipulate the knowledge. The third properties are inferential efficiency, which refers to the ability to direct inference methods into productive directions and respond with limited resources. Finally, acquisitional efficiency refers to the ability to acquire new knowledge, ideally or automatically [30].

Designing an Artificial Intelligence (AI) problem-solving application requires strategies to solve specific problems as it will depend on one type of knowledge representation. AI requires a large amount of knowledge and a mechanism to manipulate the knowledge or information to create a solution. Specific knowledge representation models allow for more powerful inference mechanisms to guide the search for a solution

[31]. AI ability to solve a problem depends on the ability to represent knowledge about the world. AI reason with the knowledge or information to obtain meaningful answers. The development of knowledge representation must be rich and close to the predicament to express the knowledge needed to solve the problem through computational gain [32].

Knowledge representation can take the form of a knowledge model. Knowledge Modelling can simulate intelligence as envisioned in Society 5.0 to enhance innovation, progress and prosperity, and all depends heavily on making the "right decisions". Knowledge Modelling is a critical element of cognitive discipline and a prerequisite for reaching true AI. It incorporates the quantitative and qualitative use of information and processes tangible and intangible attributes that contribute to a decision. Other benefit includes the ability to constantly monitor, improve and assist humans to learn from past decisions, assess present activities and preserve domain expertise [33].

Therefore, achieving the Society 5.0 vision in solving one of the prominent social issues through AI requires a knowledge representation of SME creditworthiness. The representation can be conceptualized into a knowledge model that enables IR 4.0 technologies to continuously improve social wellbeing and achieve balance economic development. The knowledge representation of SME creditworthiness will consist of specific domain knowledge and information that forms the knowledge model.

5 Characteristic of SME Creditworthiness Knowledge Model

The development of the SME Creditworthiness Knowledge Model must consider specific characteristic that applies to the creditworthiness domain. The model is built on knowledge and modelled for an intelligent agent to perform reasoning and decision-making. The discussion on the characteristic of the knowledge model is to ensure the applied knowledge for decision-making is valid, mature, and high quality [34]. A low-quality knowledge base will prompt the intelligent agent to make loosely based decision-making. Each knowledge is a combination of various determinant classified together into two main characteristics, including a discussion on the role of knowledge representation.

5.1 Hard-Information

The hard-information, mainly financial or standard banking ratios is a conventional but significant determinant applied in assessing borrower creditworthiness. Hard-information is information recorded as numbers such as financial statements, payment history, or quantity of output. It is in quantitative form and can easily be collected, stored, and transmitted electronically. The context during information collection is not significant, and data collection does not need to be personal [35]. Banking and other financial institutions rely heavily on hard-information to assess borrower's creditworthiness.

There are three main dimensions of hard-information. The nature of hard-information is quantitative or a number. The collection method is impersonal or does not depend upon the context of its production, therefore hard-information exhaustive and

explicit. Finally, hard-information is not susceptible to cognitive factors such as subjective judgement, opinions and perception. Collecting hard-information is low cost and easily automated with technology. It has a comparability and verifiability element, allowing a separate process of collecting and using the information [36].

Hard-information exhibits greater inference of high grade or worthy borrowers. The creditworthiness representation is based on verified financial information applies by banks to screen borrowers [37]. Therefore, hard-information is essential in comparing creditworthiness across borrowers and categories of borrowers. It is a fundamental element in risk management mechanisms that can mitigate information asymmetry [38]. There are three different class of hard-information consist of profitability conditions, solvency and liquidity conditions and quality of credit relation. The three-class indicate business capabilities in generating profit, meeting long term and short-term financial commitment and obligation, and credit behavior.

In this section, the characteristic discussion provides an overview of hard-information. Financial information has become the basis of the credit risk assessment model across the different financial market. Hard-information has been proven theoretically and in the general practice of their reliability to gauge borrower creditworthiness. Therefore, hard-information will be the fundamental knowledge in the creditworthiness knowledge model.

5.2 Soft-Information

The role of soft-information in financial markets has grown significantly in characterizing the lending environment and influencing the design of the lending market [35]. Since SMEs are weak in financial infrastructure and lack transparency, extending credit to the sector has become an obstacle. With limited hard-information, assessing borrower creditworthiness requires the lending market to rely more heavily on soft-information [39]. Small business loans rely more on relationship lending due to a lack of hard-information [40].

There is a variety of costless information that help improve market transparency, efficiency and provide a better signal on borrower's creditworthiness. Soft-information provides valuable input in credit appraisal, and together with hard-information will improve the loan performance. The use of soft-information became a possible alternative and a complementary solution to address information asymmetry. Soft-information signals the reliability of the business owner, however, it is subjective to cognitive interpretation [41].

The soft-information capability to increase hard-information predictive power is documented in empirical research that aims at investigating the qualitative factor impact on default risk prediction. The information is in qualitative form and non-verifiable, therefore manipulable, but produces a more precise estimation of the borrower quality, despite the subjective judgment, opinions and perception [36]. The determinant can be classified into demographic characteristics and social capital, and each of the determinants influences future loan performance. The demographic characteristics consist of determinants like age, race, gender and origin. Social capital or social connectivity can be friends, groups and a picture of the borrower [42].

The interconnected nature of society in cyberspace through various social platforms has open new possibilities in expanding soft-information determinant. Information diffusion through the online network can be collected and applied in improving lending outcomes for both high and low-risk borrowers [43]. It is considered a digital footprint, and the determinant possesses a discriminatory ability to determine borrower creditworthiness. The digital footprint can be considered as a proxy for income, character and reputation and is highly valuable for default prediction [44].

In this section, the soft-information characteristic provides an overview and potential of the newly available information to enhance the credit assessment process in determining SME creditworthiness. The addition of soft-information must complement hard-information to feed the credit assessment model because of SME limited information. Therefore, this class of determinants must be applied in the knowledge model.

5.3 Role of Knowledge Representation

The final characteristic discusses the role of knowledge representation. Each role provides a characteristic view of the knowledge model in representing specific knowledge. The knowledge model must represent all the knowledge of creditworthiness pertaining to SME borrower in lending. The roles are based on [29] description and presented below.

Table 1. Role of Knowledge Representation

Role	Description	Creditworthiness Representation
Role 1	A Knowledge Representation Is a Surrogate	Functions as a surrogate inside a reasoner. The knowledge representation enables an intelligent entity to determine SME borrower creditworthiness.
Role 2	A Knowledge Representation Is a Set of Ontological Commitments	The knowledge representation is an approximation to reality, meaning the knowledge is relevant to be applied in determining SME creditworthiness.
Role 3	A Knowledge Representation Is a Fragmentary Theory of Intelligent Reasoning	Intelligent reasoning indicates how people reason intelligently. The knowledge representation will enable an intelligent entity to distinguish between worthy and unworthy SME borrower to receive their loan request.
Role 4	A Knowledge Representation Is a Medium for Efficient Computation	Reasoning in a machine is a computational process. The knowledge representation will enable the computational process of the determinants that represent SME borrower regardless of the applied assessment methodology.

Role 5	A Knowledge Representation Is a Medium of Human Expression	Medium of expressing worthy and unworthy borrower to receive funding.

6 Conclusion

Society 5.0 agenda on the advanced fusion of cyberspace and physical space presents an opportunity to reengineer creditworthiness representation because of new technology available in collecting, analyzing and sharing knowledge. IR4.0 innovative technologies are pushing society towards the post-computing age into a new digital era. The field of AI enables computer systems to behave intelligently and goes beyond numerical computations and manipulations. AI programs focus on problems that require reasoning to solve the problem. The success in solving problems depends naturally on the ability to represent the knowledge about the world that enables the AI to reason with the knowledge to obtain meaningful answers.

AI-based on big data should be applied to its full potential in achieving AI-autonomous credit risk assessment on SME borrower. Technological innovation can optimize the credit risk mechanism to a new level, improve lending efficiency and promote financial inclusion. Conventional risk mechanism in banking may not be sufficient to represent the risky segment of the borrower market. Our proposed solution on knowledge representation of SME creditworthiness can become the basis for building an AI system and mitigate information asymmetry issue in lending.

6.1 Future Research and Limitation

Society 5.0 vision offers an exciting future in enhancing socio-economic development with the help of IR4.0 innovative technology. Developing a complete knowledge representation of creditworthiness requires extensive research. The knowledge model development must consider reusability across different economies and different risk level. Classical or modern theory on the quantitative aspect of creditworthiness knowledge domain has been thoroughly developed by scholars and applied in conventional lending. Future research opens a new opportunity to investigate suitable qualitative aspect and alternative data to supplement hard-financial information for credit assessment. The development of the creditworthiness knowledge model must consider a future empirical study to test the knowledge model in a real-world application.

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The Determinants and Interest on Mobile Commerce Adoption among East Coast Entrepreneurs in Malaysia

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Abstract. Mobile commerce among rural entrepreneurs is still in the infancy stage. This study investigates the determinants and interest of mobile commerce usage among east coast entrepreneurs in Malaysia regarding purchase and sale activities. A questionnaire was adopted and adapted from the Unified Theory of Acceptance and Use of Technology (UTAUT) and previous empirical studies. 400 questionnaires were distributed through online and face-to-face survey methods for the east coast entrepreneurs in Malaysia. The purposive and snowball sampling method was applied in this study. 360 samples were subsequently analysed using descriptive statistics and multiple linear regression analysis aided by SPSS 26.0. The study found that social influence was the most significant factor in mobile commerce utilisation among east coast entrepreneurs in Malaysia. About 71.1% of east coast entrepreneurs in Malaysia were interested in mobile commerce in expanding their business network at least once a month. It highlighted that the mobile commerce adoption has good attention from east coast entrepreneurs in Malaysia. The finding obtained that the east coast entrepreneurs in Malaysia were ready for implementing mobile commerce in their business activities. Hence, it added significantly to bridging the knowledge gap concerning the infancy rate of mobile commerce usage among rural entrepreneurs. This empirical study provides significant input to all stakeholders, including government, relevant stakeholders (e.g. entrepreneurs, supply chain industry, telecommunications industry, and ICT industry), and local communities to strategise further initiative mainly for society, economic and country development.

Keywords: Mobile Commerce Adoption, Determinants, Interest, Unified Theory of Acceptance and Use of Technology (UTAUT), East Coast Entrepreneurs

1 Introduction

1.1 Overview of Mobile Commerce

Malaysia Digital Economy Corporation in 2020 stated that the high rates of mobile phone users display a good start for Malaysian to be involved with mobile commerce,

which may contribute significantly in leading Malaysia's digital economy forward. Mobile electronic commerce is one of the many subsets of electronic commerce. Mobile commerce is a pairing of mobile devices that directly uses a mobile terminal and a wireless access network with a commercial transaction and other convention activities [1]. In other words, mobile commerce can be translated as the use of cellular phones to perform commercial transactions online, comprising the purchase and sale of products.

Mobile commerce usage needs to flourish to meet the customer's demand, as the demands of the consumers for quicker access to information about product and services increasing day by day. [2] reported that the function of mobile devices is not limited to communication purposes, but it is valuable for information gathering, various commercial activities, and business and financial transaction, hence contributing to the possibility of mobile commerce utilization that grows progressively [3]. Mobile commerce corporations are one of the fastest-growing sectors at present. It has turned into an essential trade operation, which accounts for 62 percent, 37 percent, and 1 percent of users who made an online purchase via mobile phones, laptop or desktop, and other means respectively [4]. These proportions demonstrate that mobile devices are preferable than others in purchase and transaction activities. It may help consumers manage business activities, get better profitability through effective communication, reduce business-related travels, time-saving, and speed internal processes [5].

However, [6] and [7] indicated that mobile usage in business activity, especially among rural entrepreneurs in Malaysia, is still in the infancy stage due to the greater challenges they face than urban entrepreneurs. These challenges must be overcome by identifying the key determinants that encourage them to accept technology transformed. In addition, today's situation needs them to take a drastic shift from the traditional approach to full mobile commerce utilisation. This transformation is vital to facilitate them with current business trends. Otherwise, it is hard for them to survive and sustain their business. Besides, embracing the digital economy and utilising mobile commerce as part of their vital tools in running their business will ensure the sustainability of their business.

The government encourages the entrepreneurs on the mobile commerce usability in expanding the business network. For instance, the Ministry of Rural Development (MRD) has increased the entrepreneur's online presence through the e-entrepreneur programme and organised *Ekspo Inovasi Teknologi dan Keusahawanan Desa* (*INOTEKDESA*) Programme. In this situation, mobile commerce is one of the best platforms that need to be adopted as most Malaysian owns a smartphone. The increased wireless handheld device like a smartphone is one of the keys that drive mobile commerce adoption to perform commercial transactions online, like purchasing and selling products. In addition, [8] also agreed that the rise in smartphones' popularity unlocks a new opportunity, needing to understand the features that identify the acceptance of mobile commerce by every person, including entrepreneurs. The effort by the government demonstrated that they are always ready to give full support to each level of entrepreneur's whether urban or rural entrepreneurs.

However, the level of mobile commerce usability among rural entrepreneurs and the key determinant that encourage entrepreneurs to use mobile commerce needs to be

identified for the government to take the further effective initiative in helping entrepreneurs expand their businesses. Therefore, the study on analysing the key determinant that influences the use of mobile commerce and the interest level of mobile commerce adoption among east coast Malaysia's entrepreneurs must be identified. The East Coast Malaysia is selected as a study site as most rural entrepreneurs originate from these regions.

The finding of this study contributes to the new discovery in terms of the interest level of rural entrepreneurs in Malaysia towards mobile commerce adoption. It also provides the updated information as studied by [6] and [7]. At the same time, this study able to identify the key determinant of mobile commerce adoption. This output will benefit the local authorities in improving the existing plan and policy to ensure the rural entrepreneurs move forward by following the current trends incorporating the convenience and existing technology.

2 Literature Review

2.1 The Concept and the Use of Mobile Commerce in Purchase and Sale Activities

The most significant impacts of mobile commerce on business and entrepreneurship have attracted comprehensive responsiveness from various levels, including academicians, researchers, general practitioners, and policymakers [9]. Mobile-commerce is the current business technology that is changing the way organizations conduct their business, including the business to business (B2B) and business to customer (B2C) and changes stakeholder relationships [10]. The uniqueness of the mobile commerce feature has provided entrepreneurs with unprecedented flexibility and convenience in online business. Due to mobile use's popularisation supported by internet facilities, it has become a vital part of rural residents to utilize it for daily activities [11]. For entrepreneurs, it helps their business activity because the technology utilization provides residents in a rural area with a novel solution undertaking entrepreneurship transformation change [12]. They found that 18.41% increase of technology utilization will increase the entrepreneurs' online purchases and sales by 11.15% and 14.69%, respectively.

2.2 Application of Unified Technological Acceptance and Use Theory (UTAUT) in Mobile Commerce Adoption

The Unified Technological Acceptance and Use Theory (UTAUT) is the most frequent theory used to explain technology adoption, including adopting mobile commerce [8, 10, 13, 14]. It was improved by the presence of attitude and computer self-efficacy. It was used as the theoretical basis for this study since it has been widely tested and empirically validated across several fields of technology implementation [15]. Based on the previous studies, there were four main components of the UTAUT model: effort expectancy, performance expectancy, social influence, and facilitating conditions. [16] reported that the performance expectancy can be well-defined as the person trusts that using the system will enhance users' jobs. The degree to which technology adoption

will benefit the users in performing certain activities is known as effort expectancy. Whereas, the belief that existing organisational and technical infrastructures to support system implementation is named as facilitating condition. Social Influence defined as the views of a person as to whether peers and individuals of value to the person feel that he or she should participate in the action [17].

Performance expectancy will affect consumer satisfaction to continue the use of products. It was reflected as one of the core determinants of the intention towards technology adoption [18]. [3] believed that the customers would start to engage with technologies once they find them valuable. [19] acknowledged that effort expectancy is a dominant determinant in expecting the individual intention to use mobile banking. The customers will use e-banking when they recognise it has a positive impact on their jobs. [15] proved that the actual use of MOOCs for the student in higher learning education was influence by the performance expectancy and social influence. In this case, computer self-efficacy is treated as an external factor and has a significant effect on performance expectancy.

Friends, colleagues, and family were part of social effects toward using mobile commerce [17]. It denotes the belief about whether most people favour or dislike the behaviour of users in adopting new technology. [20] analysed the effect of social links to fulfil and continue mobile social applications, hence verified the crucial impacts of social influence on technology adoption. However, [8] highlighted that performance expectancy and social influence did not significantly influence the low-income group's intention to use mobile commerce. Additionally, [21] mentioned a significantly negative relationship between performance expectancy and individual intention due to the moderating effect of perceived risk.

[10] determined that effort expectancy, computer anxiety, and commitment anticipation influenced users in adopting new technology applications, including mobile commerce. The user adoption of the mobile commerce system has a substantial effect over a longer period. The study's findings by [22] declared the effort expectancy as a predictor of consumer intentions to use ATMs with Fingerprint Authentication in Ugandan Banks. It was also supported by [23] in analysing the use of smartphones for mobile learning. Surprisingly, [24] found that effort expectancy was not significant determinants of the intention to use e-government services among China citizens.

[25] reported that facilitating conditions with high-quality infrastructures significantly influence the use of mobile apps as a platform for shopping. [8] also showed that there is a significant positive relationship between facilitating conditions and the intention to use mobile commerce and declared as the best predictor for mobile commerce adoption compared to other factors including effort expectations, performance expectancy, social influence, and perceived security. However, a previous study by [26] in Saudi Arabia remarked that the facilitating condition was not significant in forecasting students' behavioural intention of mobile learning technology acceptance.

Based on the extensive literature, the previous studies produced diverging results in significant core constructs of UTAUT due to the differences in national culture and economic development that could moderate the impact of constructs of any technology adoption [8]. It is strongly believed that the output for this study might differ from the

previous studies. Hence, the UTAUT model was adapted in mobile commerce utilisation for purchasing and sales activities to analyse the key determinant and level of interest of mobile commerce adoption among east coast entrepreneurs in Malaysia. The research hypotheses of this study are as follows:

1. Hypothesis 1 (H1): Performance expectancy is a determinant for mobile commerce adoption for sale and purchase activity among east coast entrepreneurs in Malaysia.
2. Hypothesis 2 (H2): Effort expectancy is a determinant for mobile commerce adoption for sale and purchase activity among east coast entrepreneurs in Malaysia.
3. Hypothesis 3 (H3): Social influence is a determinant for mobile commerce adoption for sale and purchase activity among east coast entrepreneurs in Malaysia.
4. Hypothesis 4 (H4): Facilitating conditions are determinants for mobile commerce adoption for sale and purchase activity among east coast entrepreneurs in Malaysia.
5. Hypothesis 5 (H5): Rural entrepreneurs in east coast Malaysia are interested in using mobile commerce for sale and purchase activity.

3 Methodology

3.1 Research Design

This study employed a quantitative approach. The primary data based on the survey questionnaires were used to gather information about the determinant and the level of interest of mobile commerce adoption. A pre-test was conducted to check the validity and reliability of the questionnaire. This study established the six sections of the questionnaire based on the previous empirical literature and the UTAUT theoretical framework. The first section provides the demographic profile of each respondent. The effort expectancy, performance expectancy, social influence, and facilitating condition information were underlined in the second, third, fourth, and fifth sections. The last section encloses questions on the level of interest towards mobile commerce adoption. It was measured by using the frequency of use in a month. Specifically, the measurement ranges from ‘never use’, ‘minimum usage’, ‘moderate usage’, ‘high usage’ and ‘maximum usage’. This study used a five-point Likert scale which was measured from ‘strongly disagree’ to ‘strongly agree’ for each section except the first section.

3.2 Validity and Reliability Tests

The validity and reliability test of the questionnaires used the Content validity index and Cronbach alpha coefficient. The questionnaires were distributed to thirty respondents to check for validity and reliability. The questionnaire items were analysed using SPSS software and found that the validity and reliability to be valid with content validity above 0.7 and reliable with Cronbach alpha coefficient greater than 0.6. Hence, no updated questionnaire design is required.

3.3 Population, Sample Size and Sampling Technique

Rural entrepreneurs in East Coast Malaysia were the population for this study. The questionnaires were distributed to the rural entrepreneurs in East Coast Malaysia through face to face and an online survey. This study employed purposive and snowball sampling techniques for both surveys. The questionnaires were only given to the entrepreneurs who use mobile for business activities. The list of these groups were captured based on the suggestion by the previous respondents. The online survey was done through google form. While, the face to face survey was done at the owner premises and it took about 20 to 30 minutes per respondent to complete the questionnaire. A total of 400 questionnaires were distributed and only 360 questionnaires were returned.

3.4 Statistical Technique

The descriptive statistic and multiple linear regression analysis aided by SPSS version 26.0 were applied to examine the level of interest and determinant of mobile commerce adoption respectively. The independent variables comprise effort expectancy, performance expectancy, social influence and facilitating condition. Meanwhile, the frequency of mobile commerce usage is known as the dependent variable. Based on [22], descriptive statistics and linear regression are essential because they provide a simple and easy-to-understand presentation of the results. In addition, this method is suitable since this study is just a preliminary study.

4 Results and Discussions

4.1 Respondent's Profile

Table 1 summarized the respondents' profile. The majority of respondents were females (66.9%) and young entrepreneurs (64.1%), below 40 years old. Half of them were married (56.9%); hence they probably have their own families. In terms of education level, 42.5% of the respondents notably have at least a diploma certificate. A majority (88.1%) of the respondents had a monthly income of RM1,200 – RM5,000. Another notable point is that even though more than half of the respondents possess a maximum SPM certificate, only 7.2 per cent of them earned an income below RM1 200. These statistics showed that they were aware and willing to adopt the current technology trend, enhancing their household income even though they were not highly educated. Lastly, Table 1 indicated that most respondents have never attended any training during their business activity (73.9%). It was strongly believed that the number of rural entrepreneurs utilizing mobile commerce can be increased if they attend any training regarding the integration of technology, innovation and entrepreneurship. In addition, the number of mobile users keep increasing year by year and become an essential device for daily life activities [11].

Table 1. Demographic Profile of the Respondents

N=360	Frequency	Percentage (%)
Gender		
Male	119	33.1
Female	241	66.9
Age		
Below 30 years old	111	30.8
31 to 40 years old	120	33.3
41 to 50 years old	80	22.2
51 to 60 years old	44	12.2
61 years and above	5	1.4
Marital Status		
Married	205	56.9
Single	125	34.7
Divorced	30	8.3
Education Level		
Primary School	31	8.6
PMR/SRP	33	9.2
SPM	143	39.7
Diploma/STPM	114	31.7
Degree & Above	39	10.8
Monthly Income		
Below RM1,200	26	7.2
RM1,201 – RM3,000	163	45.3
RM3,001 – RM5,000	154	42.8
RM5,001 and above	17	4.7
Training		
Never	266	73.9
1 to 2 times	82	22.8
3 times and above	12	3.3

4.2 Determinant of Mobile Commerce

Next, this paper seeks to identify the determinant of mobile commerce adoption among rural entrepreneurs in East Coast Malaysia. By using multiple linear regression analysis, this study found that all four (performance expectation, effort expectation, social influence and facilitating condition) components of UTAUT have significantly influenced mobile commerce adoption. As presented in Table 2, the attributes of performance expectation ($\beta = 0.222$, $p < 0.01$), effort expectation ($\beta = 0.318$, $p < 0.01$), facilitating conditions ($\beta = 0.192$, $p < 0.01$), and social influence ($\beta = 0.241$, $p < 0.01$) were positively and significantly affecting the entrepreneurs' mobile commerce utilization at 1 percent significant level. The findings were supported by [8, 15, 22]. An R-squared

of 86.1% reveals that 86.1% of the data fit the regression model. This study demonstrated that performance expectation, effort expectation, social influence and facilitating condition were the main determinants for mobile commerce adoption among rural entrepreneurs in East Coast Malaysia. Thus, this study supported hypothesis 1,2,3 and 4.

The results determine that social influence was the most influential factor affecting mobile commerce usage among rural entrepreneurs. The finding reveals that peoples' experience influenced mobile commerce adoption among entrepreneurs in using it. Family, friends and IT experts are the potential groups that inspire rural entrepreneurs to use mobile commerce. In addition, [22] believed that word of mouth by reference groups play a crucial role in influencing rural entrepreneurs to use mobile commerce. Effort expectation was the second most substantial factor that encouraged rural entrepreneurs to use mobile commerce. The finding reveals that entrepreneurs can easily learn mobile commerce since most (64.2%) are young entrepreneurs (age below 40). The youth are more aware of innovations as they may have experience of various technologies and have good fundamental knowledge in applying them [2]. Performance expectation was also a factor of mobile commerce utilization. This result shows that rural entrepreneurs in East Coast Malaysia's mobile-commerce are optimistic and expect their success. The rural entrepreneurs believe using mobile commerce is useful and helpful because it may improve identity assurance and security of their money while carrying out business transactions. These results were supported by [10] and [22]. Instead of having a direct relationship between effort and performance expectation and mobile commerce usage, [27] believed that personal innovativeness would mediate the relationship between effort expectancy and performance expectancy and behavioural intentions to adopt mobile commerce.

The least influential factor was facilitating condition. This study referred to facilitating condition as the existing facilities including hardware and software materials, skill and knowledge and human resources. Compared with other factors, these facilities do not strongly help entrepreneurs engage with mobile commerce application. The reason is the mobile commerce is still new types of e-commerce which is the users were not familiar well with their interface and facilities offered. Thus, it seems necessary to provide essential technology resources, information and continuous support to encourage rural entrepreneurs to use mobile commerce [22].

Table 2. Determinants of Mobile Commerce Adoption (MCA)

Hypothesis Path	Std. Beta	t-value	R^2
H1: Performance expectancy → MCA	0.222	8.482***	0.861
H2: Effort expectancy → MCA	0.318	9.694***	
H3: Facilitating condition → MCA	0.192	6.647***	
H4: Social Influence → MCA	0.241	9.884***	

Note: ***p<0.01, **p<0.05, *p<0.1

4.3 Level of Interest on Mobile Commerce

This study posed a simple question to the respondents to gauge their interest in whether they were interested in using mobile commerce to expand their business network. By using the descriptive statistical analysis, the results were very encouraging as shown in Table 3, where 71.1 per cent of rural entrepreneurs indicated that they had used mobile commerce at least once a month. Most of them were from a group below than 41 years old. The youngster group interested to integrate technology into entrepreneurship activity. They accepted the technology changes and were willing to move forward in ensuring that they are not left behind in business activities. They were also interested in integrating the technology components in their business activity by fully utilising the existing technology for income generation. The finding also revealed that the rural entrepreneurs responded positively and were ready for mobile commerce adoption. It showed a good start for the entrepreneurs because Insider Intelligence forecasts that mobile commerce will inch closer to become consumers' preferred channel for online shopping within the next five years. Hence, it was believed that mobile commerce continues to evolve more popular. Thus, this study supported hypothesis 5.

Table 3. Mobile Commerce Adoption by Rural Entrepreneurs

Mobile commerce Utilization per month	Frequency	Percentage(%)
Never Use (0)	104	28.9
Minimum (1-2)	32	8.9
Moderate (3-5)	75	20.8
High (6-10)	117	32.5
Maximum (11 and above)	32	8.9

5 Conclusion and Recommendation

This study concluded that performance expectancy, effort expectancy, social influence and facilitating condition were determinants of mobile commerce adoption for sale and purchase activity among rural entrepreneurs in East Coast Malaysia. This study also concluded that 71.1% of rural entrepreneurs in East Coast Malaysia were interested in using mobile commerce in expanding their business network. It highlighted that they were ready to implement mobile commerce in their business. Hence, supports the government agenda and believes this kind of technology transformation adoption is significant for their business growth. This valuable finding is vital for the government to strategize further initiatives to boost rural entrepreneurs' business growth.

6 Limitations and Future Study

This study found that 28.9 percent of rural entrepreneurs were not involved with mobile commerce, and it was believed that the percentage might be more than that due to the number of samples collected were just 400. The finding will be more informative if

future research could involve more sample size and extend the current study on identifying the barriers that the rural entrepreneurs face in engaging with mobile commerce in their business. Other than that, subsequent research should implement the structural equation modelling method since the current approach has certain limitations.

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Effects of Home Office on Employees' Working Conditions during Covid 19 Crisis in Switzerland

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Abstract. The current pandemic poses special challenges for employees. A survey was conducted in April and May 2020. The impact of the switch to home office on the living circumstances, quality of life and Well-Being was investigated. 333 respondents (female 62%, male 38%) participated in this survey. The results show there during these weeks a high level of Well-Being in the home office. More than 70% of respondents feel comfortable in home office and would like to maintain this type of work organization after the corona crisis. Leadership is a decisive factor. Working conditions at home (suitable working environment, undisturbed work) are less decisive for Well-Being than good leadership by the superior. Findings show the necessity of clear communication rules, so that employees are optimally integrated into the work processes and content. In addition, a high degree of personal autonomy in the home office and, at the same time, close integration into the team is important for the Well-Being of employees. Employees would like to keep the autonomy they gained even after the crisis. However, there are increasing demands due to digital leadership. Under these conditions, leadership means providing orientation and support from a physical distance, as well as promoting the autonomy of the employee. As a negative impact of home office, it can be stated that employees miss regular social exchange with colleagues. In consequence, the presence at the workplace should be used as quality time for building sustainable and resilient working relationships.

Keywords: Abstract. Keywords: Home office • Working conditions • Well-Being

1 Initial Situation

The world is for more than one and a half years now in the pandemic crisis. With the change from office work to home office, the working and living conditions changed fundamentally [18]. The authors conducted a survey in March and April 2020 in order to determine to what extent the change to a home office has influenced the living conditions, quality of life and Well-Being of employees [3, 5, 8].
The present study also aims to investigate whether leadership principles that have already proven effective in everyday business life are also effective in the home office

and whether there is a connection (correlation) between digital leadership, Well-Being and resilience in the home office.

2 Home Office in Switzerland

Teleworking and home office is not a new phenomenon. According to the Swiss Federal Statistical Office, in 2018 about 138,000 people were working more than 50% of their working time in so-called teleworking from home. Another 445,000 were regularly in their home office, but with less than 50% of their workload. An additional 478,000 employees did this occasionally [1]. It can be assumed that of the 5.1 million jobs in Switzerland [2], the vast majority of employees have switched to home office work during the pandemic crisis. In 2016, 87% of employees wanted to have more of a home office, with the proportion of temporary home offices at that time standing at 28% [4]. By 2014, about half of the 4.9 million employees in Switzerland would already have been able to work from home or on the move, both in organisational and technological terms [11].

In principle, the home office offers many advantages, but also disadvantages. First of all, it saves time for users because commuting is no longer necessary. Working hours can also be made more flexible. The prerequisite is that the home office has the technical and Organisational-spatial prerequisites to carry out productive work. The disadvantages may be that the manager has to make additional efforts to accompany employees in their home office. In addition, personal social contacts are limited because the home office organisation means that colleagues are seen less often. Personal contacts cannot be fully compensated for by voice and video calls.

3 Digital Leadership

During the crisis, leadership made an important shift from leading employees in presence to do called digital leadership. There are various characteristics of digital leadership, it requires leadership at a distance without direct personal contact between leaders and guided persons, the use of suitable software tools and the application and implementation of basic leadership principles. Furthermore, good digital leadership is characterised by the fact that, despite "social distancing", an empathic relationship between the superior person and the employee is maintained even via virtual communication.

The basic principles of effective and efficient management include, above all

- clarifying the roles of team members in the delivery of services.
- clarification of tasks and duties of the home office staff.
- clarifying the integration into the operational processes.
- allowing freedom to bring in own ideas.
- the application and effectiveness of the principles of digital leadership
- establishing clear rules of communication in dealing with other group members.

4 COVID-19 - Challenges for Employees and Management

The pandemic poses special challenges for employees and their families. Home office under the conditions of the pandemic also means that freedom of movement is fundamentally restricted. Employees are faced with additional tasks, such as organizing their daily lives while at the same time reducing social contacts. Or looking after children and instructing them in distance learning. Many of the employees also worry about relatives and friends who are not well cared for, who need help or who may even be ill. Quite a few employees are worried about whether and how long they will keep their jobs, whether Short-time work will be introduced and whether they can stick to their career plans under the very uncertain conditions. For many employees, the pandemic poses many different challenges and burdens. But each of these burdens has its own quality. It is obvious to speak of the pandemic as an event that brings with it very different burdens and can certainly trigger a crisis. This crisis is a crisis for society and the economy, but it is also a crisis or critical life event for individual employees. What makes such an event a crisis? Fore sure there was hardly any preparation time, a pandemic is only foreseeable to a limited extent, we can only draw on a few experiences, the interrelationships are complex and difficult to manage, the negative effects are difficult to control, and living at loss has a lasting negative impact on Well-Being. Such emotional problems can put a strain on social relationships and also promote illness. The special thing about the pandemic is that it affects everyone. It is also special that we can understand the restrictions as a service to the community. This helps to deal with the negative consequences [6].

5 Resilience and Competence

In this context, we are working on the assumption that in the course of one's professional life, challenges will always arise that will have to be overcome. Under certain circumstances, this may lead to a reorientation, to a development of professional skills in everyday work as well as to an adjustment of one's own goals, wishes and interests. If coping with these challenges is successful, one speaks of "career adaptability" or "career resilience". Here, resilience is defined as successful professional action under difficult Job-related conditions. As with the general concept of resilience, personal and environmental risks and strengths are considered decisive for positive coping.

Work in the home office under conditions of the pandemic is now subject to a variety of stresses and strains that can, but need not, be associated with the pandemic. Other burdens can be added and all of them together can have a lasting negative impact on people's thinking, feeling and acting. People who are burdened but cope well with these burdens are considered resilient. Resilience is often understood as "the positive adaptation and sustainable development of a system to respond to Short- or Longer-term everyday challenges or severe stress. Based on internal system processes and through dealing with the environment, the system defines new reference values and develops required competencies, and the ability to cope with future stresses improves" [13, p.557]. It is therefore not just a matter of overcoming a challenge or coping with pressures. It is also about the acquisition of skills and competencies, about changing attitudes so that future challenges can be better mastered. Whether or not such a

development takes place depends to a large extent on the strengths and support available within the person and in the environment. And it is certainly decisive whether and to what extent it is possible to positively influence the strengths within the person or the support in the environment. It is therefore a matter of direct control of what is happening as well as influencing all factors that can influence the perception and shaping of what is happening. An important contribution to Well-Being is that I can influence the essential factors of what is happening and thus have control over the current and future development. Resilience and Self-Efficacy (resilience and Self-Efficacy in Figure 1) are therefore closely related [14].

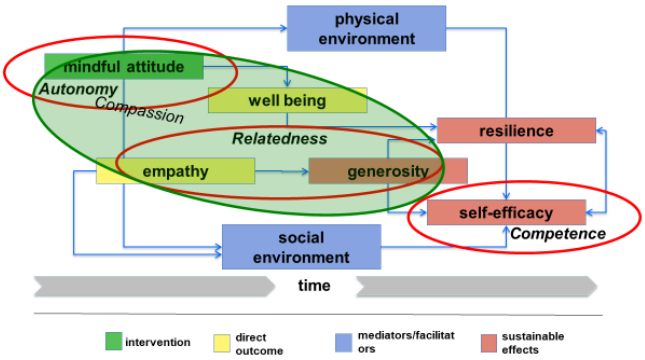

Figure 1: Factor model mindfulness, resilience, and social support over the life span [17].

Within the framework of our joint work in the research network "Mindfulness, resilience, and peer support across the life span" we have designed a model of conditions in which mindfulness and Well-Being, empathy and generosity are important factors on the individual side. With them Self-Efficacy and resilience can be promoted. This model is based on the basic assumption that people only consistently direct their actions towards Well-Being, health and their own positive development if the actions themselves serve their basic needs. The basic needs include autonomy, integration in social relationships and the experience of competence. Compassion and generosity, i.e. the willingness to stand up for others, to participate, are not only educational or socialisation goals but also important basic conditions of human life.

6 Research Questions and Design

Certain aspects of the COVID-19 crisis can now be understood as a particular constellation in the physical and social environment of the employees. It should be remembered that home office in general and home office under the conditions of the COVID-19 crisis are not the same. Under the influence of the COVID-19 crisis, personal freedoms are severely restricted. This also poses special challenges for management. Under

difficult conditions, it has a positive influence on motivation and performance and has to make its contribution to ensure productivity. The home office is no longer a right, but rather a civic duty, combined with the duty to perform the required work in the home office as well. In addition, large parts of the population not only have health concerns, but also considerable uncertainty about the safety of their own workplace. This outlines a field of hypotheses and variables that the questionnaire must take into account.

One of the basic conditions of human life is that environmental conditions influence individual behaviour and experience and individual development [15]. The social dimensions of employment, but also the social dimensions of family and friends, of the living environment and the community have an influence on the course of development. In addition, we assume that aspects of the physical environment are important protective factors or even pose risks. An attractive residential environment with plenty of space, green spaces and opportunities for leisure activities is generally regarded as a protection factor, while noise pollution and various disturbances are considered risk factors, e.g., also for work in the home office. It is therefore obvious that in this survey we have considered aspects of behaviour and experience, work organisation and management, as well as life design and the home environment. In detail, we asked for eight biographical data and data on professional biography. They were asked about the extent and duration of work in the home office, the occupational field and type of employment, as well as attitudes towards work in the home office.

Well-Being and resilience were surveyed using standardised questionnaires. Standardised questions on teamwork and team leadership complemented the various aspects of home office work. The physical environment became an issue by asking about living space, rooms and number of people, but also about the quality of the residential area and the wider living environment. The survey was completed on 21 May 2020. The survey involved 333 respondents* (female 62%, male 38%). Most of them have been working as employees in the service sector (economy, education, social affairs, administration) for more than 15 years. The respondents were invited by spreading requests through various distribution lists and target groups. This means that the link to the questionnaire was sent via the authors' networks and then forwarded to third parties by other helpers.

7 Objectives of the Survey

The survey served to assess the Well-Being and the experience of stress in the home office in times of the COVID-19 crisis. From the data obtained, recommendations can be deduced for work in the home office, for the design of interaction under the conditions of virtually mediated communication and leadership. These recommendations are helpful in the current situation as an impulse for consultation as well as for the design of management. They will also be helpful in the future, when more work is done from the home office and thus hybrid forms of work are to be promoted.

Key questions of the project therefore concerned:

- Individual Well-Being and individual resilience under home office conditions due to pandemic.
- The satisfaction with this special form of work.

- The satisfaction with the work in the team and with the leadership.
- The social and physical protection factors in the environment in their importance for the evaluation of work, and one's own Well-Being and resilience.
- The application and effectiveness of principles of digital leadership.

8 Structure of the Questionnaire

At the beginning, the respondents were informed about the purpose of the survey and about anonymity, confidentiality and the central concerns and structure of the survey: "With these questions we would like to know how working conditions and work experience under the influence of home office in quarantine are. We would like to assure you that all your information is confidential, and that the evaluation will be anonymous. With your information you will help us to better understand this new situation and to be able to give better advice. Thank you very much for your support! The questionnaire has two parts. The first part deals with everything that characterizes the current work situation. The second part focuses on your personal attitudes."

The questionaries covered different aspects: Questions about age, gender, accommodation were followed by questions related to the type and duration of work, current employment and current occupational field. This was followed by the Well-Known WHO questionnaire on Well-Being [19]. Resilience was surveyed via a questionnaire developed by Schumacher and colleagues [9]. The questionnaire by Singh and Kolekar served to measure commitment [12]. Leadership style was measured by the scale developed by Janssen and van Yperen [7]. In addition, the employees were asked to evaluate their living environment using items from the former DFG Knowledge Transfer Project on Social Change and Neighbourhood by Claus-Christian Wiegandt, University of Bonn.

9 Results part I: Demographic Part. Questions about the Living, Professional and Working Situation

To describe the sample, it should be noted that the average age of the respondents is 42.17 years (N=317). The proportion of women in this sample is 59.2% (N=320). The average age of women and men is comparable. The vast majority of the respondents live in a household with two to four persons (N=238 of 320). Just over 25% live in a household with at least one child under the age of 17. Slightly more than 10% have a family member over 60 years old. 75% have an apartment with more than 80 square meters (239 of 318). About 10% report that they are living in quarantine. This means that they are infected themselves or have been in direct contact with an infected person (N= 33 of 310). Regarding the occupational situation, we have information on the employment relationship and the occupational field.

There are no significant differences in the duration of employment in the individual occupational areas. Most have been employed for 10 or 13 years.

We can also assume that the majority of respondents work with virtual tools, feel well oriented in the group and in their tasks, and can actively participate in the work. And that they tend not to feel lost or suffer from distractions from third parties.

With a similar scaling, the respondents seem to feel rather well. Their resilience is quite pronounced. Attitudes toward the team are also described as constructive. The employees pay attention to the contribution they themselves can make to good teamwork. Even if one's own contribution to the success of teamwork is seen, the influence and importance of leadership is definitely perceived more concisely. The respondents are thoroughly satisfied or relatively satisfied with their neighbourhood. Opportunities for active and "healthy" leisure activities are probably of particular importance.

10 Results Part II: Personal Attitudes toward Home Office, Well-Being, and Resilience

As the data show, Well-Being and resilience are closely related to satisfaction with the neighbourhood and the opportunities for active leisure activities. In the following, the two key variables Well-Being and resilience will serve as reference variables for aspects of leadership or "absolute" and relative time in the home office. There are strong links between resilience and Well-Being on the one hand and team leadership scores on the other. The actual time spent in the home office, on the other hand, has no influence on Well-Being and resilience. As the data show, however, there is a very close correlation between general satisfaction with the work situation ("I am satisfied with the new home office job") and the Well-Being or resilience of the employees. The autonomy of the work in the home office quite obviously also makes a decisive contribution to this ("I see opportunities to work autonomously").

11 Statements with great Significance for Well-Being and Resilience

In the following section, this gives us the opportunity, as an interim conclusion, to name those statements that are of great importance for successfully coping with work and life under the conditions of the pandemic.

In our findings, a large number of variables are moderately or strongly related to each other. How can these variables be meaningfully ordered? We elaborated a factor analysis. The majority of the items load quite high on one main factor. This main factor stands for "performance," for successful work in the home office and under the special conditions of the pandemic. Satisfaction with the work situation, general Well-Being and resilience go hand in hand with the perception of autonomy, role security, task clarity and good communication in the team [16, 17].

As a result of the factor analysis relating working conditions to resilience and Well-Being (three components were extracted via principal component analysis), one main factor emerges that lists conditions for a successful home office: (1) I am happy with the new home office work (.597). (2) I see opportunities for me to work autonomously (.537). (3) My role in my group (team) is clear to me (.509). (4) I know my

tasks and duties (.548). (5) I know how I am involved in the operational processes (.609). (6) I have the freedom to contribute and implement my ideas (.567). (7) There are clear communication rules when dealing with my group members (.592). (8) I would like to keep this form of work (home office) even after the COVID-19 crisis (.616). (9) I miss the interpersonal contacts I had in my old work environment (.462). (10) I wish to return to the previous organization of my work in my ancestral workplace (.463)

12 Evaluation and Interpretation

In this era of the COVID-19 pandemic, one's Well-Being in the home office is dependent on individual, social and other environmental factors.

High level of Well-Being in the home office: More than 70% of respondents feel comfortable or very comfortable in the home office and would like to maintain this type of work organization after the COVID-19 crisis.

Leadership as a decisive factor: The working conditions at home (suitable working environment, undisturbed work) are less decisive for Well-Being than good leadership by the superior. Clear communication rules: Rules for communication and processes must be defined so that employees are optimally involved in the work processes and content.

Desire for autonomy: Great personal autonomy in the home office and simultaneous close integration into the team are particularly important for Well-Being when working at home. The employees would like to retain the autonomy they have gained even after the crisis. If it becomes clear that productivity can also be ensured in the home office, then any restriction of this newly gained freedom could lead to a loss of motivation.

Increasing demands due to digital leadership: Under these conditions, leadership means providing orientation and support from a physical distance and promoting the autonomy of the employee. This sets new standards and demands on management. It is becoming more demanding because employees have become more independent [10].

Home office as a normal form of work: It can be assumed that pressure will increase to allow home office as an equal or even normal form of work even after the COVID-19 crisis.

Lack of social exchange: At the same time, respondents miss regular social exchange with colleagues.

Quality Time: Presence at the workplace should be used as quality time. On-Site work meetings will remain important in the future for building sustainable and resilient working relationships. Physical meetings will become quality time for creative meetings and innovation workshops.

13 Outlook

The present results are quite encouraging. They show that many feel up to the challenge of converting their work to home office and that personal attitudes, social

relationships and good guidance from management are important protective factors for remaining fit for work even under the more difficult conditions of the pandemic. Furthermore, they also show where consulting needs can arise, and which offers could promote positive coping with the upcoming challenges. Politicians should be encouraged to foster home office working conditions. Employers should acknowledge the fact that home office infrastructures would enhance employees to strengthen their motivation, productivity and well-being.

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Apprenticeship-Based Entrepreneurship Education: Review of Malaysia Approach

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Abstract. Apprenticeships are regaining popularity in Malaysia. The purpose of this paper is to provide an overview of apprenticeship-based education in Malaysia, to examine current government policies, and to investigate current issues concerning further apprenticeship development. Apprenticeships have traditionally been thought of as a path to a stable job. Although they have a bad reputation at times, apprenticeship programs frequently disregard various laws and the rights of apprentices. Higher-level skills are becoming more in demand as the knowledge economy grows. This is analogous to the idea that starting a business is difficult and necessitates a lot of experience in today's competitive environment. It has an impact on the popularity of apprenticeships as well as "academic" paths such as higher education. For a graduate to receive an apprenticeship degree, several success factors must be considered. Many publications keep tabs on the nature and value of apprenticeships. This paper examines how good new practices can be applied to entrepreneurial pedagogy options, as well as the evolution of apprenticeships.

Keywords: Apprenticeships, Entrepreneurship Education, Higher Education.

1 Introduction

Entrepreneurship has emerged as a promising catalyst for diversifying economic growth and sustaining competitiveness in the face of globalization [1]. By creating new job opportunities, entrepreneurship can help developing countries revitalize stagnant economies and address poverty issues [2]. Indeed, in a country where entrepreneurship education should be prioritized, this strategy relieves the government of the burden of addressing unemployment [3]. In this context, the university, as a knowledge center, should fully embrace its role as a critical platform for encouraging entrepreneurship. As a result, many nations are empowering entrepreneurship education, fostering an entrepreneurial environment that promotes the mindset, skills, and behavior of entrepreneurs [4], [5]. As a result, the entrepreneurial entity acts as an entrepreneur, managing their careers and providing employment to society [6].

Entrepreneurship education is widely regarded as the impetus for launching a new business. It may, however, aid in the development of knowledge and skills that will be useful in future life journeys. To date, graduate starting ventures have been the primary focus of increasing interest among scholars, primarily in developed countries [7].

Because of the skills, knowledge, and mindset taught in entrepreneurship education, particularly in corporate entrepreneurship, prominent entrepreneurship graduates are thought to have a higher proclivity to start a business [8]. As a result, entrepreneurship education is one of the most effective methods of reducing unemployment because it produces more job creators than job seekers [9].

Entrepreneurship and unemployment are inextricably linked issues, and the field of entrepreneurship is one solution to this imbalance. According to Malaysia's Department of Statistics, only 2,347 graduates started their own businesses in 2015 and 2,833 in 2016[10]. Accordingly, over 200,000 graduates graduated and left higher education institutions in 2019. This means, over 200,000 job seekers try to find work in Malaysia each year, potentially increasing the country's unemployment rate. This is consistent with data from the Department of Labor, which shows that the unemployment rate remained at 4.7 percent in August 2020. "By 2020, the Higher Education Ministry expects that 15% of students will venture into entrepreneurship while still pursuing studies at institutions of higher education, with 5% of them having the primary goal of becoming entrepreneurs upon graduation," according to The Star.

Today, the increase in this statistic is even more significant because the world is dealing with health issues, resulting in a pandemic, which causes a slowdown in the economic sector and, as a result, an increase in unemployment. The Malaysian Statistics Department reports that the unemployment rate for 2020 has been set at 5.5 percent as a result of the movement control order (MCO) imposed to prevent the spread of Covid-19. This is the highest unemployment rate since the 1990s, when it was 5.7 percent. Previously, the Statistics Department reported that the unemployment rate in the second quarter was 4.7 percent, with a slight decrease in the number of people aged 15 to 64 to 741,600. From July of the previous year, there was a 0.5 percent decrease.

The government and universities are critical in addressing the unemployment is-sue and combating the rising unemployment rate. Several initiatives have been launched by the government to reduce graduate unemployment. As a result, in early 2013, the Malaysian government began designing and developing the Malaysian Education Blueprint (MEB) 2015-2025 through the Ministry of Higher Education. Under the new education policies, the government fosters an entrepreneurial culture, particularly among graduates and universities, and leads the ecosystem. Graduates are increasingly creating jobs rather than looking for them [12].

In July 2020, the government reintroduced the National Apprenticeship Scheme (SPN), which is more focused on apprenticeship programs to increase the rate of graduate employability among those affected by covid-19 pandemics. This multi-ministry collaboration is a youth and sports ministry initiative to increase youth employability and provide training and employment opportunities. According to a report from the Malaysian Ministry of Youth and Sports, as of November 2020, 397 apprentices had participated in the program, with 376 interns benefiting from job placement. It means, 94.7 percent were successful and went on to work for the companies that participated in this program. The program's goals include: (1) increasing apprentices' marketability through "soft skills" and on-the-job training; (2) providing a support system for youth to help them get jobs; (3) assisting in the re-duction of youth unemployment; and (4) signing up 5,000 people using the Human Resources Development Fund's (HRDF)

"place and train" concept. The SPN pro-gramme, on the other hand, is more concerned with reducing the immediate unemployment rate, regardless of employment field. According to the Ministry of Human Resources, over 67 companies registered with HRDF and InvestKL have participated in this SPN program to train and employ the young and unemployed. The goal of this paper is to examine the landscape and meaning of entrepreneurial apprenticeship, as well as to investigate the potential critical issues and challenges encountered in developing an agenda or policy relating to a graduate entrepreneurial apprenticeship [13].

2 Apprenticeship Based Learning for Entrepreneurship in Malaysia

Throughout history, the term "apprenticeship" has been defined in various ways [14]. Today, it most commonly refers to education or training that provides students with marketable skills to start their own business or careers. Apprenticeship exists in a liminal space between training and work environment. An apprentice will be exposed to a challenging working environment, and even the stereotypical mandatory task of making photocopies is commonly regarded as a rite of passage [15]. The lack of a well-defined position frequently contributes to unscrupulous employers exploiting employees through apprenticeships by promising valuable training.

As a concept, internships refer to the process of learning in natural work environments through authentic work activities and interactions. The programs typically involve a group or business arrangement to gain experience, skills, or contacts for future employment opportunities [16]. Apprenticeships, on the other hand, are high-intensity and high-frequency forms of work-based learning in which the learner spends the majority of their time in the industries where they acquire the majority of their skills. The majority of apprenticeships and traineeships last two to four years [17]. An entrepreneurial apprenticeship, on the other hand, allows an apprentice to gain valuable entrepreneurial skills, a network, and an understanding of running a growing business in exchange for hard work and a low wage.

The Ministry of Education announced the Malaysia Education Blueprint 2015-2025 (Higher Education) in 2013, with the goal of increasing previous graduate employability by more than 80% by 2025. One strategy for improving graduate entrepreneurs, graduate employability, and skill mismatch is to implement an industry-led curriculum. In this regard, universities and industry must collaborate to co-create appropriate curriculum. To help graduates improve their entrepreneurial skills, the Ministry of Education launched an entrepreneurial apprenticeship program. This new learning strategy encourages businesses to collaborate with universities to create curricula that provide students with a more comprehensive entrepreneurial experience. The Entrepreneurship Apprenticeship Program will be supported by mentors from academia and industry [12] with expertise both on and off campus.

Participants in the Entrepreneurship Apprenticeship Program can study on campus for two years before beginning a year of apprenticeship training. During the final year of their studies, the candidate will eventually manage his or her own business. Through

an entrepreneurial venture that emphasized work-based learning models, the curriculum was developed to increase the employability of local graduates. Graduates typically participate in a specific work placement for an extended period of one or two years in the industry, typically between the third and final year of their undergraduate program. Universities must carefully consider their relevant pro-grammes to the industry and entrepreneurial environment in response to industry feedback that university graduates are unqualified and lack specific capabilities [12].

The concept of entrepreneurial apprenticeship-based learning is not new, and it has already been adopted by many other developing countries. In Malaysia, however, industry professionals will collaborate to develop academic curricula that are much more relevant to the needs of entrepreneurial development. Additionally, graduates' exposure to industry locations to experience this curriculum allows them to gain confidence and virtual business experience. A graduate who has prior experience and actively participates in a practical and constructive learning program will im-prove their graduate profile, self-confidence, productivity, emotional intelligence, and leadership skills. The most important aspect of an entrepreneurial apprentice-ship program is that graduates develop relevant, practical entrepreneurial skills through content-based, university-industry collaborative pedagogy [12].

3 Key Considerations for Improvement

Because the young are the ones who will drive the country forward, and their role in ensuring the country's global competitiveness will be critical in the future [18]. Without a doubt, they are among the most important contributors to economic and social development. As a result, a country must be prepared to improve the development of their business skills in order for them to become proficient in conducting business in a natural business environment while also contributing to the growth of the country's economy through the creation of various job opportunities. This means that, in order to develop the entrepreneurial sector, the government's policy to im-prove the quality of entrepreneurial apprenticeships must be considered [19]. Some justifications serve as primary benchmarks in the development of an entrepreneurial apprentice system that allows graduates to start new businesses. However, some issues impede the creation of excellent and efficient entrepreneurial apprenticeships.

3.1 Cost of Living

When choosing an apprenticeship placement, students always consider the cost of completing an apprenticeship. It can result in more serious problems, such as gaining access to potential employers and apprenticeship placement opportunities [20]. Graduates who will be undergoing training will be required, as is customary, to relocate and live off-campus in major cities such as Klang Valley, Johor Bahru, and Penang, where their living costs will rise and be a significant factor in choosing an apprenticeship. The monthly cost of living in a big city like Kuala Lumpur, according to Belanjawanku, will be more than RM 1,870. A person uses public transportation to get to work. Obtaining financial support from parents may be one of the financial resources available when the

apprentice undertakes the placement to assist the apprentice in completing an apprenticeship. Inequality in access to excellent learning support will result from a lack of financial aid, which will limit apprentice-ship opportunities [21]. The apprentice's costs may also influence their decision to take a low-quality or irrelevant apprenticeship placement. Another thing to remember is that those entrepreneurial apprentices are usually required to pay their fees for the duration of the apprenticeship, even if they are not attending classes that semester [22].

3.2 Apprenticeship Rights

Unpaid apprenticeship programs and paid apprenticeship programs are legally distinct. This results in a double injustice for the apprentice, who interprets the apprenticeship as falling between the gaps of employment law and graduate protection law. An apprentice who does not receive any salary payment violates the concept of employment and is denied the employee's rights and benefits under employment law, including the payment of the minimum wage. Apprentices who do not obtain employee rights may be denied other employee rights, such as protection from sexual harassment and workplace discrimination [23]. This example shows how the need to consider equating workers' rights with apprenticeship rights can be linked to achieving an inclusive learning environment.

3.3 Industry Desire

Under the apprenticeship scheme, industry workers assigned to mentor the apprentice must devote time and energy to supervising the apprentice [24]. Industries, on the other hand, have limited resources such as skilled workers, space, and equipment. Although the majority of these industries only hire one or two apprentices, it can benefit the industries, as well as small and medium-sized businesses. Even if it is unpaid labor, it may be difficult to shoulder the responsibilities of industries to train apprentices. In Malaysia, small and medium-sized businesses account for 98.5 percent of all businesses (SMEs). Malaysian SMEs devote the least amount of their annual budget to training and development, according to the Khazanah Research Institute (KRI) Report. As a result of granting the apprentice the right to an essential employee, the burden on the company's ability to continue operating will be in-creased. As a result, one of the company's stakeholders withdraws from the apprenticeship program [25]. This happens because the company's profitability is the primary goal in its future planning, and it will be evaluated on an annual basis. As a result, industries invest in less profitable and less volatile projects. The goal of entrepreneurial apprenticeships for both the apprentice and the university is to produce experienced, skilled, and successful entrepreneurs who will build their businesses after graduation. This goal harms industries' perceptions of the apprenticeship pro-gramme because the apprentices they train will become competitors in their business. As a result, policy considerations must be made to balance industry, university, and apprentice motivation.

3.4 Enrichment of Academic Opportunities

As part of the graduation requirements, most programs require a 3-to-6-month internship at the company. As a result, more students in higher education institutions are looking for internship opportunities. Approximately 250,000 students will find internship opportunities each year. Unfortunately, universities have no control over their students' availability to work in the industry [26]. Competition for an apprenticeship can be both positive and negative because students pursuing an entrepreneurial apprenticeship must undergo comprehensive learning by mastering natural entrepreneurial environments in order to prepare apprentices to build their businesses in the future [25]. As a result, it is difficult for the industry to train a large number of entrepreneurial apprenticeships at the same time in order to provide comprehensive training. Hundreds of thousands of students from other majors have applied for internships at their companies as well. As a result, the placement of students is skewed. These apprentices may perform irrelevant apprenticeships and fail to meet the apprenticeship objectives if they are not properly guided [27]. Because of the placement competition, the apprentice will be treated poorly while completing the apprenticeship. Higher education institutions should collaborate and form close relationships with industry in the future to ensure a steady supply of high-quality entrepreneurial apprenticeships.

3.5 Rules and Regulations

The accessibility and effectiveness of new laws and regulations to protect the rights of apprentices should be emphasized [28]. When implementing the law on an apprenticeship, various cost implications must be borne by the apprentice, industry, or university in order to make the apprenticeship a compelling and excellent scheme. This implementation, on the other hand, has the potential to establish a legal framework between apprentices, industries, and universities in areas such as whistleblowing, workplace discrimination, and sexual harassment. It can also explain the various issues and challenges encountered when enforcing apprenticeship rules and regulations. In this case, reaching an agreement on the best practice law for improving self-regulation during the apprenticeship is required.

4 Conclusion

The importance of dynamic capabilities in micro-enterprises was investigated in this paper. Micro enterprises are important because they create long-term employment opportunities and contribute to developing economies. In this regard, the government should focus more on assisting micro-enterprises to survive in a crisis. Furthermore, micro-enterprises must restructure their operations by implementing necessary improvements, such as digitization. This can be accomplished by collaborating with strategic partners such as Grab, Foodpanda, Shoppee, Lazada, and others. In light of the fact that micro-enterprises are being forced to close their doors due to continuous losses as demand has declined, they must identify various alternatives that are appropriate for the critical situation. It is during a crisis that the full potential of micro-enterprises can

be realized. People are aware that the pandemic reduces the likelihood of micro-enterprises surviving; however, micro-enterprises can still make a massive comeback by adapting to market changes. It is therefore critical for micro-enterprises to have entrepreneurial leadership qualities in order for them to survive.

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Using Natural Language Processing to Detect Fake News

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Abstract. Over the last few years, the world has seen what feels like an explosion of fake news due to social media and technological advancements. Even though fake news is not a new phenomenon, it is one of the biggest challenges in our digitally connected world as it spreads like wildfire impacting a significant number of individuals daily. Social media platforms such as WhatsApp, Twitter, and Facebook allow for the distribution of fake news which can potentially impact the social, political, and economic aspects of the world as it becomes more prevalent presenting dire consequences. This research benchmarks multiple Natural Language Processing (NLP) classifiers against a common dataset to determine to what extent the classifiers can detect fake news. The research also introduces natural language features that can be used to better classify fake news. The dataset includes 12 836 short statements labelled for truthfulness, subject, context/venue, speaker, state, party and prior history. The sources used to collect the dataset include political debate, TV adverts, Facebook, Twitter, interviews, news release et cetera. The results show that the accuracy of a piece of an article being classified as fake news is based on the analysis of previously seen truthful and fake news. On this basis, an increase in more samples may help improve the results and should be considered when building a fake news classifier. The results also showed an improvement in classifying fake news when bespoke features are added to the classification of articles.

Keywords: Natural Language Processing, Fake News, Detection.

1 Introduction

The growing influence of the fake news phenomenon on social media is not exactly new, but the abundance of fake news has made it harder for an individual to discern the truth as every source of information needs to be fact-checked (Thorne & Vlachos, 2018). The Internet has empowered the spread of fake news by providing multiple low-cost dissemination channels (Pollicino, 2017). The posting of fake news on discussion forums, online journals, and social media platforms requires very little specialized skill, reaching immense crowds through the span of a couple of hours. Research on the reasons for the exponential growth of fake news on social platforms has focused on psychological measures (Roozenbeek et al., 2019) and fewer efforts on how it can be avoided or prevented. The change in the history of fake news is that previously only certain individuals could effectively spread fake news, nowadays anyone with Internet

access can easily publish it (Tsfati et al., 2020). The scale of fake news in recent history has created an issue of being able to quickly classify and filter out fake news before it is consumed. The classification of fake news using short text is important to quickly filter out or flag potential fake news before it is consumed.

In order to improve current classification techniques, it would help to extract context from the articles to try to learn how fake news mostly exaggerates or misleads with highly inconsistent information. Fake news can be classified by leveraging a large array of language models that have been built. However, building such an algorithm poses challenges such as the ability to source both truthful and fake news examples, and being able to indicate if it is clearly genuine or fabricated news (Zhou et al., 2019). According to Conroy (2015) NLP accomplishes impressive precision on existing instances of manipulated news, this is achieved by checking if the news article conforms to standard norms and styles used by expert writers. The model can detect fake news when the content is completely different from the headline or when the article incorporates words viewed as being biased or provocative. However, by preserving the original subject matter and relating content closer to the headline without using bias or provocative words, the article can easily bypass detection. Despite the outcome that is generated by the model, online platforms still rely on manual work to segregate fake news from real news.

Based on the above one may argue that some form of fact-based knowledge must be adopted alongside NLP models in order to reduce the high rate of false positives, hence making this an area of research that requires further investigation (Zhou, Guan, Bhat, & Hsu, 2019). This research proposed a technological solution to an issue that was not necessarily constructed yet unquestionably intensified by digital platforms. NLP tools were used to build a fake news detection classifier. The methodology focuses on presenting a comparative performance analysis of existing methods and incorporating different features from existing works and investigating the performance of some successful text classification techniques. The LIAR dataset was used to address these issues. The LIAR dataset includes 12 836 short statements labelled for truthfulness, subject, context/venue, speaker, state, party, and prior history. The sources used to collect the dataset include political debate, TV adverts, Facebook, Twitter, interviews, news releases etc. A lengthy analysis report is provided by the labeller to ground each judgement, and the links to all the supporting documents are also provided (Wang, 2017). The LIAR dataset is used in this research particularly for a second challenge addressed by this research, which is the classification of short text for fake news. This research will address the notion that most social media posts on platforms like Twitter allow only for short tweets of 280 characters (Perez, 2018), and thus having a solution that is able to deal with these types of fake news important.

This research benchmarked multiple NLP classifiers against a common dataset to determine to what extent the classifiers can detect fake news. Although this is a field that has been explored, examining multiple NLP classifiers on a common dataset helps ensure that there is uniformity in the research and benchmarks the models on an even fit. For this reason, the main research question of this research is: *To what extent can an NLP classifier be used to detect fake news?*

The following section provides a brief background on fake news detection mechanisms and introduces different machine learning approaches, evaluation methods and models. Section three details the methodology followed in conducting the experiment. Section four and five presents the results of the evaluation and conclusions of the study.

2 Literature Review

2.1 Fake News Detection

Research that focused on detecting deceptive review opinions in sentiment analysis was conducted by (Fayazi et al., 2015). The study utilized a crowdsourcing approach that relies heavily on the wisdom of the crowd to vote if something is false or true where the majority vote is taken as the final answer. This method uses a swarm intelligence approach however has the drawback of a delayed classification, as you need people to slowly flag the fake news and by the time the detection is done it may be too late and people have acted on the misleading information. A key part of the research that can be reused is in how the training data set for a fake news detection model needs to use a swarm approach to better filter the noise and bias from the person labelling the training dataset. The use of ensemble methods in machine learning can be used to mimic this voting by crowds however this will be more effective as it does not require a waiting period for people to vote.

The headlines of a fake news article may intend to invoke emotion or physical response from the reader by having exaggerated text, while the text or content of the text is not aligned with the headline. A hybrid deep model for fake news detection which makes use of multiple kinds of features such as allocating a score to suspicious users was later proposed by (Ruchansky, 2017). The research by Ruchansky (2017) highlights the importance of building a historical view of authors and the articles they have written in order to build confidence and understanding of the type of articles they produce.

Technologies such as Artificial Intelligence (AI) and Natural Language Processing (NLP) tools offer great promise for researchers to build systems that could automatically detect fake news (Bondielli et al., 2019). Various machine learning approaches and algorithms as well as their key traits are introduced in the following sections.

2.2 Machine Learning Approaches

Machine learning is a subfield of AI that enables machines to improve at a given task with experience (Edgar & Manz, 2017). Early machine learning algorithms aimed to learn representations of basic functions. Consequently, the objective of learning was to yield a hypothesis that performed the correct classification of the training data, and early learning algorithms were intended to find such a precise fit to the data (Wittek, 2014). Modelling text brings forth many challenges as the text is known to be unstructured. Machine learning algorithms cannot work with the raw text directly; it requires well-defined fixed-length inputs and outputs and therefore the conversion of text into

vectors is imperative in order to reflect numerous linguistic properties of the text. A number of machine learning approaches exist and is briefly explained below.

Bag of words. Bag of words is a method used to represent text data when modelling, it is recognized for its great success in problems that involve language modelling and document classification (Tani et al., 2015).

Term Frequency-Inverse Document Frequency (TF-IDF). TF-IDF measures how frequently a word is used in a text. The advantage with TF-IDF is that it devalues stop words. The disadvantage is if the words are not normalized there is a likelihood that the scoring would be inaccurate (Yang et al., 2008).

Word2Vec. Word2vec creates vectors that are distributed numerically as representations of word features, such as the context of individual words. It does so without human intervention (Ayyadevara, 2019). The Word2Vec algorithm finds much more efficient representations by finding vectors that represent the words. These vectors also contain semantic information about the words. It groups similar words together in the vector-space by distinguishing similarities mathematically (Kang et al., 2019).

Global vector for Word Representation (GloVe). GloVe works by firstly creating a large word-context-co-occurrence matrix, consisting of (word, context) pairs in that each of the elements contained in the matrix represents how regular a word occurs with the context. The number of contexts needs to be large as it is essentially combinatorial in size. Subsequently, they factorize the matrix to yield a lower-dimensional matrix of words and features, where each line yields a vector representation for each word. It is accomplished by minimizing the reconstruction loss which searches for lower-dimensional representations that can clarify the difference in the high-dimensional data (Pennington et al., 2014). GloVe aims to take global information into account while learning dimensions of meaning. From this initial goal, GloVe builds up a principled method of training word vectors.

2.3 Evaluation Metrics

A number of machine learning evaluation metrices exist. Due to space constraint these metrices will only be briefly explained.

Area Under the Curve (AUC). Area under the curve (AUC) is used for binary classification problems and indicates how well the probabilities from the positive classes are separated from the negative classes. AUC is the area under the receiver operating characteristic (ROC) curve which constitutes of true positive rate, true negative rate and false positive rate classes (Huang et al., 2005).

Recall. Recall looks at the accuracy of the model by referring to the percentage of total relevant results correctly classified by the algorithm. How recall works is that it takes the number of true positives, divides it by the number of true positives plus the number of false negatives (Carterette, 2009).

Precision. Precision is a valid choice of evaluation metric when the aim is to predict accurately. Precision is defined as the number of true positives divided by the number of true positives plus the number of false positives (Goutte et al., 2005).

F1 Score. F1 Score is the Harmonic Mean between precision and recall for a classification problem. The range for F1 Score is [0, 1] which gives an indication of how precise the classifier is; in other words, how many instances it classifies correctly, as well as how robust it is; that it does not miss a significant number of instances (Goutte et al. 2005).

Accuracy. The accuracy of a model is the ratio of correct predictions to the total number of input samples. It is suited for binary as well as a multiclass classification problem. Accuracy is a valid choice of evaluation for classification problems that are well balanced and not skewed (Hossin et al., 2015). Accuracy is a measure used to determine which model is best at identifying relationships and patterns between variables in a database based on the input data.

Matthew Correlation Coefficient (MCC). Essentially MCC is a correlation coefficient between the observed and predicted binary classifications which returns a value between -1 and + 1, where -1 indicates a disagreement between prediction and observation, 0 represents a random prediction while +1 is a perfect prediction. The coefficient accounts for true and false positives and negatives and can be used even where classes are of very different sizes (Zhu, 2020).

Cohen Kappa. Cohen Kappa was initially created to test inter-rater reliability, in the most recent decades, Cohen's kappa entered the machine learning space in order to compare classifiers' performances. Despite its ubiquity, in the learning setting, there are various issues causing the kappa measure to deliver questionable outcomes, for example, its high affectability to the dispersion of the minimal aggregates. Cohen's kappa statistic is a very good measure that can handle very well both multi-class and imbalanced class problems.

Cross Validation. Cross validation is a technique used to estimate the accuracy of machine learning models whereby the model is trained using a subset of the dataset and then evaluated using the complementary subset of the dataset. In building any machine learning model it is required that the problem be properly identified so that the most suitable algorithm is chosen so that it results in the best score (Hjorth, 2017). Both non-

exhaustive methods such as Holdout (Yadav et al., 2016) and K-fold cross validation (Meijer, 2013) exist, as well as exhaustive methods such as Leave-P-Out cross validation (Hibbert, 2017).

2.4 Machine Learning Models

The following machine learning models are available:

Logistic regression. This function was developed by statisticians to explain the properties of population growth in ecology as it was rising quickly and maxing out the carrying capacity of the environment (Menard, 2010).

Support Vector Machines (SVM). SVM is a supervised machine learning algorithm that can be applied for both classification and regression use-cases. SVM works by trying to find a hyperplane that best divides a dataset into two classes by vectorising each data point with several dimensions which equates to the number of the attributes that the model considers when classifying data. SVM aims to maximize predictive accuracy while avoiding overfitting to the data.

Tree Based Models. Tree based models are non-parametric supervised learning methods used for classification and regression. The objective is to create a model that predicts the estimation of an objective variable by taking in basic choice guidelines derived from the data features. Examples of tree-based models include Random forest (Xue et al, 2015), Gradient boosting algorithm (Wang et al, 2018), XGBoost (Chen et al, 2016) and Lightweight GBM (Machado et al, 2019).

3 Methodology

Multiple types of machine learning models were trained on the LIAR dataset using only the text field in the data. The models that performed the best on the dataset were selected based on their ability to properly classify fake or real news statements. The LIAR dataset has become the de-facto standard in modern fake news detection benchmarks and is publicly available. The dataset contains 12.8K manually labelled short statements in various contexts from Politifact[1], which provides detailed analysis reports and links to source documents for each case (Wang, 2017). After the dataset was collected various pre-processing methods were employed and some machine learning models were trained and evaluated on the data. The best performing models were measured on specific metrics such as accuracy, precision, recall, and F1 score. Further comparison between traditional NLP methods and deep learning context-based models was evaluated. The research were finalized by synthesizing and interpreting the results.

[1] https://www.politifact.com

4 Modelling Experiments and Results

This section briefly details (due to space constraint) the most important model training process and results and a summary of the evaluation results.

4.1 Model Training and Results

The initial round of models was used to build multiple base pipelines that worked to extract the statement field in the data and run it with TFDIF, GloVe, or Bespoke features as the initial step of pre-processing and feature extracting. The model that performed the best was the GloVe Random Forest as it showed the highest F1 Score, at 38%. A major problem that was observed with most of the models in the first modelling approach is that the scoring difference between the training and testing was so vastly different. It was clear that the highly complex models are overfitting the dataset and that good generalized models need to be found. This then informed the approach for the second round of modelling which focused more on a cross validation type of training which ensured that the model generalizes across multiple samples of the data.

Given the results from the initial model, GloVe emerged as a text feature extraction mechanism was a good way of getting meaning from the data. All the models were then trained on a combination of GloVe and Bespoke features that were created for this project. Given the large dimensions of the GloVe vector for each document which was 96 elements in size, dimensionality reduction using UMAP (Uniform Manifold Approximation and Projection for Dimension Reduction) was also employed (Mcinnes et al., 2018). This resulted in a training set that had 49 features which comprised of 39 bespoke features and 10 components from the redacted GloVe features using UMAP. Part of the pre-processing of the data is the creation of new features based on interactions between features and polynomial features that create combinations of features. This expands the data set to 341 features, for the sake of simplicity where it will only cover these features if they appear in the top 15 features list.

5-Fold cross validation was employed and included the LIAR datasets validation set in the overall dataset. The 5-Fold cross validation will be based on 80% of data with a 20% unseen dataset for us to use for evaluation purposes. After preparing all this data for training, the dataset was ran across multiple models.

When using the dataset in the second approach, it was seen that the tree-based ensemble methods are the best models at classifying the dataset. The results from the mean 5-fold cross validation scores showed more stable results. The best model being Gradient Boosting Machine with an AUC of 61% which is 11% higher than a random model.

From the top models, hyperparameter tuning using a grid search was used to tune the models.

After tuning the models, the top model was benchmarked. This was done by training on instances of the model on each fold and testing out the results. The performance of the top model was tested on the unseen data.

Table 1. Validation Results

Model	Accu-racy	AUC	Recall	Prec.	F1	Kappa	MCC
Gradient Boosting Classifier	0.6451	0.6012	0.1015	0.503	0.1689	0.0563	0.0857
Bagging Classifier	0.6751	0.7404	0.1259	0.7574	0.2159	0.1275	0.2105

The model performed very much consistent with how it performed on the training set. This makes it a very stable method as the training cross validation score matches the unseen validation data.

Using a bagging model significantly improves the performance of the model as the model's results jumped to 74% AUC with an improved MCC as well as F1 Score. The results of both these models are illustrated in Table 1.

4.2 Summarizing Evaluation Results

From the models in the first stage, it was observed that the first benchmarks look like and the results that can be achieved with TFIDF vs GloVe vs GloVe UMAP. Using TFIDF, it was shown that simplistic models can extract more meaning from the data where more complex models and mainly the three based models seem to over-fit especially when using the default settings and underperform on the dataset. Given that there is little text in the statements made in the LIAR dataset it would make sense that the model should not be highly complex as this may generate very highly biased models that would not give the best results. Model performance was also evaluated when the GloVe embeddings are used on the data. In the second approach, a more streamlined approach was followed by using the same pre-processing technique which showed great success in the first round which was the GloVe+UMAP+Bespoke feature approach. The Bespoke method tied in the use of text generated, entity-based features, and sentiment-based features. In this approach, a wider range of models were considered and their performance were evaluated from mean 4-fold cross validation. The best model was selected by using the AUC as a metric. To see if that model could be improved further, the bagging approach was employed by using 10 versions of the top model and training them as voting classifiers. This improved the results significantly to 74% AUC. The resulting model was able to classify short text in the LIAR dataset as Fake or Real. The shortcomings of this model are:

- **Text Length**: The LIAR dataset is based on very short texts and this task would be even hard for a human to do without context.
- **Using just Text**: Most attempts at training a classifier on the LIAR dataset do this by using all fields in the dataset. The proposed model will classify classify fake news solely based on text.
- **Data Gap**: Although the dataset is extensive it would be helpful if the dataset was much larger

5 Research Findings and Conclusion

From the previous section, it emerged that the GBM model was the best model. The model's parameters are as follows:

```
GradientBoostingClassifier (ccp_alpha=0.0, crite-
rion='friedman_mse', init=None,
learning_rate=0.1, loss='deviance', max_depth=3,
max_features=None, max_leaf_nodes=None,
min_impurity_decrease=0.0, min_impurity_split=None,
min_samples_leaf=1, min_samples_split=2,
min_weight_fraction_leaf=0.0, n_estimators=100,
n_iter_no_change=None, presort='deprecated',
random_state=6387, subsample=1.0, tol=0.0001,
validation_fraction=0.1, verbose=0,
warm_start=False)
```

The model has a maximum depth of 3 which shows that the model creates a very simplistic relationship within the data. This is the main metric that emerged when considering the parameters. It supported the notion that given the short text found in the LIAR dataset it would make sense that the models that do draw inference from this data are too complex. The maximum depths ensure that the relationships are not too complex. From the results of the model, it showed that the GBM model has a cross validation AUC mean of 60% and this can be seen from the ROC Curve shown in Fig 1.

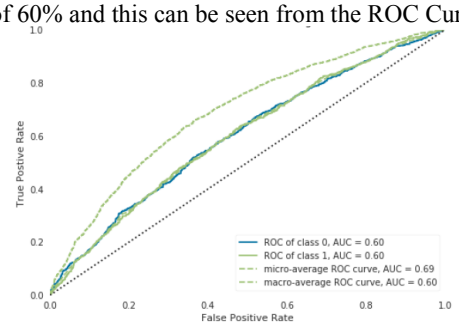

Fig. 1. ROC for Gradient boosting classifier

The model performance was evaluated across other metrics which show that the model has a hard time classifying documents as fake or real. This is to be expected as most of the text looks the same in the statements of the LIAR dataset. The model seems more conservative in predicting fake news and this is given that fake news is the minor class in the fake news or fake statement problem.

The precision-recall curve was explored to determine the trade-off between precision and recall for different thresholds. The models show a high precision which gives the view that the model has a relatively low false-positive rate which helps ensure that the model is precise about its prediction of a fake statement.

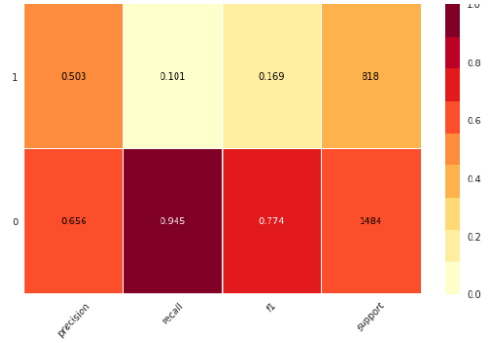

Fig. 2. GBM classification matrix

The chart below shows the average precision to be around 44%.

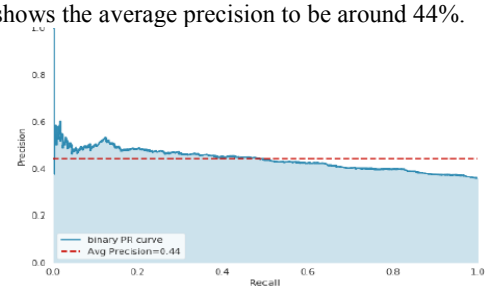

Fig. 3. Precision-Recall Curve for Gradient Boosting Classifier

In response to the research question, the literature presented in section 2 indicates that NLP is being used as a means to detect fake news. This research, proposed steps to extract information from text and use machine learning to classify text into fake or real news. Section 4 briefly detailed the results of the experiment to evaluate the best model to achieve this.

This research highlighted that the best way to discern if a model is doing well or not is by comparing the different types of metrics. Cross validating was added to ensure that the models' output was not being affected by sample bias and that the key results derived from the model were a genuine performance.

Pipeline and pre-processing steps were proposed to train the models. The final model structure showed the most promising results, which was to use GloVe word embedding with bespoke features. This incorporated the notion that to classify if an article is fake or not you have to understand how something was said using the bespoke text features by getting a numerical GloVe embedding of the text. A major drawback was the length of text found in the LIAR dataset. The text is rather short and does not give the model too much to work with, however, this is also an advantage of the model as learning from short text mimics a lot about today's society in the world of social media where fake news can be shared by a single tweet. Although complex, this research serves as s a first view of what is possible with using just short text to classify fake news.

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Flexible Workforce Management. An exploratory Study

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Abstract. A flexible workforce is a key competitive advantage to deal with a constantly changing environment, such as order fluctuations and filling knowledge gaps due to a shortage of skilled staff. So far, only few empirical results are available on how companies successfully manage the "Flexible Workforce". In the present exploratory study, we examine the flexible workforce practice and management in Swiss organisations using a quantitative approach. Data were collected through an online survey, in which 224 HR professionals of Swiss companies took part. The results suggest that organisations engaging in a flexible workforce benefit from outcomes like dealing with peaks in workload, filling knowledge gaps, implementation of new ideas and succession planning. The extent to which companies can benefit from the use of a flexible workforce depends, among other things, on the complexity of the tasks and organisational characteristics such as the culture of trust and the practice of knowledge management.

Keywords: Flexible Workforce Management · Contingent Worker · External Flexibility · Survey

1 Introduction

The world of business is changing and the shape of the workforce with it [1]. Organisations must be flexible to be successful in the fourth industrial revolution. Organisations change to become more flexible and in order for organisations to be flexible, a flexible workforce might be a good option [2].

Already since the mid-70s [3], organisations have been interested in flexible organisations and alternative work arrangements to face challenges like uncertainty, technological change like the spread of the internet, globalisation or market stagnation [4-6]. Back then, Lynch [5] claimed organisational flexibility is not an option but a necessity. This is still true more than 30 years later. Flexibility gains momentum in the course of the debate about so-called "megatrends" [7]. Technology, demography and globalisation are drivers for the future of work [6] and underlie the need for organisations to have greater flexibility of employment systems [8]. Organisations see flexibility potential increasingly within the organisation's human resources [9]. A sustainable fit in dynamic and competitive environments can only be achieved by a flexible organisation,

which is also part of strategic HRM to promote [10]. Kalleberg [8] further emphasises the importance of human resources practices that enable organisations to adapt quickly to social and economic changes.

At the same time, there are not only positive but also negative voices with regards to flexibility [11]. The concept of flexibility is discussed controversially in terms of negative effects on employees and society [12]. Part of the problem might be the wide use of the term flexibility and lack of specification or assuming only one-sided benefits [12]. Paradoxically, flexibility from the organisations' perspective might lead to restrictions from the employee's perspective and vice versa [11]. There is a distinction between having flexibility or being flexible [13], with typically the organisation having flexibility and the employee being flexible [11]. Reilly [12] argues that of course there are some areas with benefits for one side only, however, there are also areas where benefits for both parties exist, for example multi-skilling: Organisations may benefit from improved productivity and employees from enhanced skills [12].

Yet, there is still only little research on flexibility strategies resulting in mutual advantages for both employees and organisations.

The aim of the present study with an exploratory character is to gain insights into labour flexibility strategies of Swiss organisations, analysing potential flexibility benefits and dipping deeper into success factors for the management of a blended workforce. The results of the study might provide a starting point for HR professionals to strengthen flexible workforce practice in Swiss organisations.

2 Flexible Workforce

2.1 Strategies of Labour Flexibility

Flexibility can be described as "a firm's abilities to respond to various demands from dynamic competitive environments" [14]. It is the ability of a firm to adapt to environmental changes by quickly reconfiguring activities and resources [10]. Based on this definition and from an organisational perspective, labour flexibility relates to the allocation of the workforce in accordance with varying requirements of production and customers [11]. For an organisation to be flexible, a flexible workforce might be a good option [2]. Researchers have focused on two different flexible labour utilisation strategies [8]: internal vs. external flexibility [15] functional vs. numerical flexibility [4,12], organisation-focused vs. job-focused [16] or resource vs. coordination flexibility [14]. Either organisations focus on the ability of employees to perform a variety of different jobs or limit the involvement of employees within the organisation by hiring temporary employees [8]. Coordination flexibility, external flexibility, job-focus flexibility or numerical flexibility describe the use of external employment to enhance firm performance and allow organisations to reconfigure, resynthesize and redeploy human capital as needed [17]. Resource flexibility, internal flexibility, organisation-focused or functional flexibility describe the flexibility based on the existing pool of human resources in an organisation [9] and the encouragement of employees to adopt to expandable work roles [18]. It is about enhancing employees' skills to perform a variety of different jobs [8].

Workforce planning appears to be one of the top challenges for organisations [19] and labour flexibility became an increasingly important research topic in the past years [20].

2.2 The Flexible Firm

In the past, studies primarily focused on either one or the other flexible labour utility strategy [8]. Concerning functional flexibility, scholars described correlates of high-performance work systems [8] as well as positive outcomes on labour productivity and innovation performance of organisations [21], and reduced involuntary and voluntary turnover [15]. However, organisations seem to prefer numerical flexibility [21]. Research on numerical flexibility was mainly about cost reduction and increased competitiveness through externalisation [8] or effects on employees [22-25]. However, only a few studies focused on the interplay between functional and numerical flexibility [8] like the "flexible firm". The "flexible firm" or the core-periphery model is the most popular model combining both flexibility strategies and was introduced by Atkinson [4]. However it is criticised for mainly focusing on an accurate representation of numerical and functional flexibility and for being too narrow [8]. In addition, it meets mainly the needs of organisations with many low-skilled but not high-skilled employees [26]. There are other studies regarding blended workforce models [27,10] but these are criticised for primarily focusing on economic benefits for organisations [11].

2.3 Flexible Employees

In 2019, more than 26 million employees in the European Union were temporary employees [28]. Temporary engagement as part of flexible work arrangements are likely to play an increasingly important role in the future [29]. However, labour market theorists are sceptical about this development [30]. The accusation arises that in case of flexible employment relationships, contingent workers bear the costs in the form of fragile employment biographies [25]. The loss of stability, short-term employment, uncertain future prospects and financial uncertainties are seen as problematic [31]. On the other side it is argued that contingent work does not necessarily lead to precarious biographies [32,30]. Contingent employment plays an important role concerning labour market integration [7,33] and reduces the risk of long-term unemployment [32]. Flexible work is trendy and an increasing number of employees consciously decide to work as contingent workers [34].

Overall, the research focus of flexibility strategies seems to be more on the employee side and less on the organisational side [19]. Besides the studies about organisational flexibility from an organisational perspective and concerning the "flexible firm", a large body of research about organisation flexibility focused on the socio-economic level and dealt mostly with discussions about flexibility and precarious employment [35,36,12,13,23,37]. In addition, platform economy and gig economy are among the very trending research topics [38-40] in terms of numerical flexibility.

Yet, there is only limited research on flexible workforce strategies and practices, especially with a focus on Swiss organisations.

With the present study, we intend to examine the flexible workforce management of Swiss organisation to make a first, exploratory step to close the research gap. Within the framework of this study, we start by focusing on external flexibility. The study was guided by the question of how Swiss companies deploy contingent workers in the company, what strategies they are following in this regard and what advantages they can benefit from.

3 Method

3.1 Sample

In total, the final sample included 224 participants indicating that they work with contingent workers in their organisation: 66% females and 34% males contributed to the study. 80% of the participants worked in HR, 22% were members of the Management Board, owner or CEO of the company and 10% worked in another division of the company (multiple answers possible). 41% of the respondents indicate their function as HR Director, 16% as HR Manager, 12% as Managing Director and 12% as HR Business Partner, 11% as HR Specialist and 8% work in other functions. With regards to professional experience, 49% have more than 20 years, 34% have 10 to 20 years and 9% have 8 to 10 years of professional experience. Due to this response, it is assumed that the respondents are experts in the respective companies and were able to give well-founded information about the management of the flexible workforce in their organisations. Slightly more than half of the respondents (53%) work in large companies (250 and more employees), 23% in medium-sized enterprises (50-249 employees) and 12% each in small (10-49 employees) and micro enterprises (1-9 employees).

3.2 Measures

The questionnaire included almost 70 content-related questions about flexible workforce management and 10 questions regarding descriptive data. Since we did not find adequate scales measuring a flexible workforce, new items have been formulated. The survey was split into four parts: the deployment of contingent workers, the Flexible Workforce Management, the integration, collaboration, leadership and culture contingent workers face in the organisations, as well as advantages organisations benefit from by working with a contingence workforce.

3.3 Procedure

The University of Applied Sciences Northwestern Switzerland FHNW conducted the study in cooperation with HR Today, the largest Swiss HR magazine. Data gathering was obtained through a questionnaire distributed to a wide group of HR professionals. The questionnaire was distributed in summer 2020. Participants of the given random

sample completed the questionnaire online through an online survey service. The survey was promoted through HR Today, social media channels and business networks. The survey was distributed to subscribers of the HR Today newsletter, through social media channels and company networks. Furthermore, the survey was sent to alumni of selected further education programmes of the University of Applied Sciences Northwestern Switzerland FHNW.

4 Results

To describe the results, different types of statistical indicators and forms of visualisation were used, such as frequencies, tables and charts. To determine the correlations, we performed bivariate correlations (Spearman correlation tests). All statistical analyses were performed using IBM SPSS software. The tables and diagrams were created in Microsoft Excel. Prior to the assessment of the data, we reverse-coded negatively keyed items.

4.1 Descriptive Statistics

Descriptive results indicate that most of the surveyed organisations work with a very small number of contingent workers (see Figure 1). More than half of the participants (52%) indicate that only 5% or less are contingent workers in their organisation. In 23% of the companies, between 5% and 10% additional contingent workers work there. Only a small proportion of the respondents (6%) work with more than 50% contingent workers in addition to their permanent workforce. Three quarters of these are small or micro enterprises.

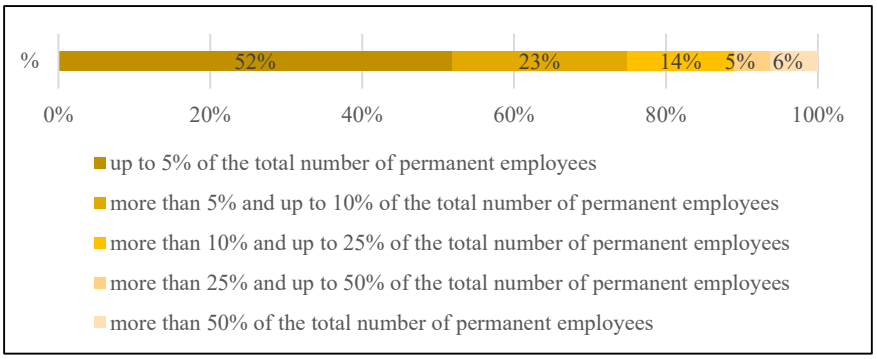

Fig. 1. Number of contingent workers in addition to the total number of permanent employees (N=191).

The majority of companies hire contingent workers for complex tasks (77%). 57% of the respondents benefit from contingent workers for simple tasks. In 34% of the cases, participants indicate that contingent workers handle both simple and complex tasks. Figure 2 indicates that most of the companies engage contingent workers for project-related assignments as well as for specialised tasks. In 47% of the companies, contingent workers form a continuous part of the organisational workforce.

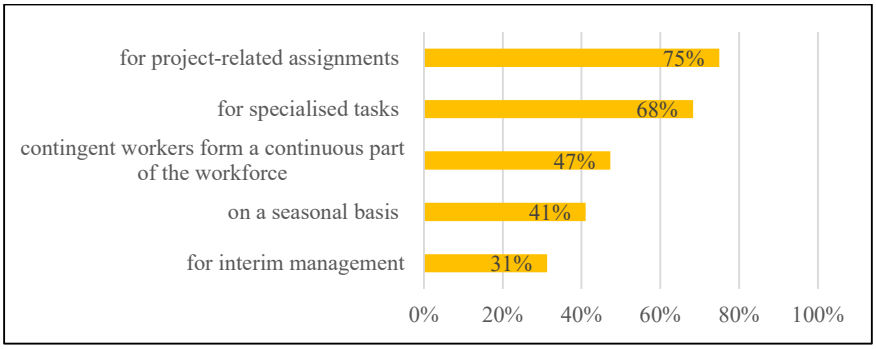

Fig. 2. Tasks for which contingent workers are deployed (N=224; multiple answers possible).

Companies working together with contingent workers benefit from different advantages (see Figure 3). For 81% of the companies, the main benefit is dealing with workload peaks. Filling of knowledge or skills gaps is also an important reward of contingent workers (more than 50% agreement). Remarkably, the reduction of personnel costs through contingent workers does not seem to be a central advantage for a large part of the surveyed companies. Furthermore, respondents were asked about the implementation of new ideas and about the selection of employees from the contingent worker pool. For these questions, the results are rather balanced.

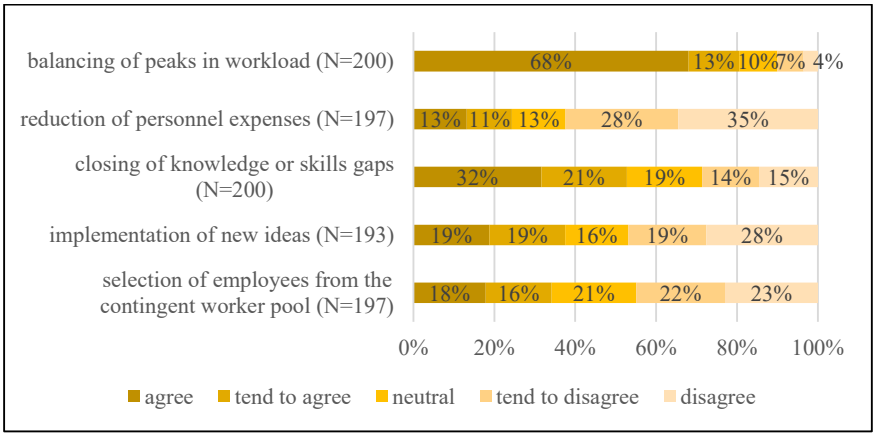

Fig. 3. Advantages through the deployment of contingent workers.

4.2 Bivariate Correlations

In addition to descriptive statistics, we investigated correlations between the above presented benefits and conditions of the company like task complexity level, organisational characteristics, and instruments.

Type of Task

Depending on how contingent workers are engaged, companies benefit from different advantages. The data shows that companies that use contingent workers for simple tasks can benefit from balancing peaks in workload (see Table 1). Companies that deploy contingent workers for complex or specialised tasks as well as for project-related assignments are more likely to succeed in filling their knowledge and competence gaps and to implement new ideas. The same applies to companies with contingent workers for interim management. In addition to the above-mentioned advantages, these companies are also able to reduce personnel costs and gain contingent workers for succession planning. Companies hiring contingent workers on a seasonal basis mainly succeed in covering workload peaks. The picture is somewhat different for organisations in which contingent workers form a continuous part of the workforce. Except for filling knowledge or skills gaps, these companies benefit from all of the examined advantages.

Table 1. Benefits of companies that use a contingent workforce depending on the type of task (Spearman correlations).

Companies that hire contingent workers...	…can benefit from				
	the balancing of peaks in workload	the reduction of personnel expenses	the closing of knowledge or skills gaps	the implementation of new ideas	the selection of suitable employees
…for simple tasks	0.34***				
…for complex tasks			0.50***	0.39***	
…for specialised tasks			0.44***	0.42***	
…for project-related assignments			0.34***	0.34***	
…for interim management		0.17*	0.25***	0.27***	0.21**
…on a seasonal basis	0.31***				
…as a continuous part of the organisational workforce	0.19*	0.21**		0.21**	0.25***

Organisational Characteristics

The results show that certain organisational characteristics are associated with greater use of benefits (see Table 2). Companies in which employees trust each other and share their knowledge are particularly successful in dealing with workload peaks through contingent workers. Inviting contingent workers to important meetings also seems to be relevant, because it appears to allow knowledge or skills gaps to be covered, as well as implementing new ideas. The same is true in companies that are concerned about keeping the knowledge of contingent workers within the firm.

Table 2. Organisational characteristics and how companies benefit from flexible workforce management (Spearman correlations).

Companies in which…	…can benefit from				
	the balancing of peaks in workload	the reduction of personnel expenses	the closing of knowledge or skills gaps	the implementation of new ideas	the selection of suitable employees
…trust between permanent employees is high	0.28***				
…a culture of knowledge sharing exists	0.23**				
…contingent workers are included in important meetings			0.20*	0.20*	
…the knowledge of contingent workers is adequately secured			0.18*	0.23**	

Instruments for Flexible Workforce Management

In addition to the organisational-specific characteristics, there are also aspects of flexible workforce management that can be influenced by the HRM department (see Table 3). Companies in which the recruitment process for contingent workers is aligned between HRM and other departments succeed in balancing workload peaks. Organisations that have defined processes for the deployment of contingent workers benefit from the same advantage. Companies using tools to identify contingent employees or include contingent workers in personnel planning tools benefit from the reduction of personnel costs. Organisations that have specific employer marketing for contingent workers in place or provide measures to maintain relationships with contingent workers benefit from the same. Surveyed companies who indicate that they have a designated "FlexManager", who is mainly responsible for the management of the Flexible Workforce, can not only reduce personnel costs, but also adjust for peaks in workload. Moreover, they are more successful in gaining contingent workers for permanent positions. The latter advantage also applies to companies that offer contingent workers access to training and further education.

Table 3. Instruments for FlexWork Management and how companies benefit from the HR instruments of flexible workforce management (Spearman correlations).

Companies in which…	…can benefit from				
	the balancing of peaks in workload	the reduction of personnel expenses	the closing of knowledge or skills gaps	the implementation of new ideas	the selection of suitable employees
…the coordination between the HRM department and other departments involved in the search for contingent workers is good	0.18*				
…processes for the deployment of contingent workers are defined	0.16*				
…procedures or tools to identify flexible workforce resources are used		0.20*			
… contingent workers are included in personnel planning tools		0.22**			
…an employer marketing programme for contingent workers is carried out		0.18*			
…measures are in place to maintain relations with contingent workers		0.23**			
…there is one person (or several persons) whose main task is flexible workforce management ("FlexManager")	0.19*	0.21**			0.15*
…contingent workers have access to training and further education					0.23**

5 Discussion and Conclusion

5.1 Strategies and benefits of Flexible Workforce

The current explorative study examined external labour flexibility utilisation patterns in Swiss organisations and intended to investigate effects on organisation-related outcomes. The majority of organisations rely on a flexible workforce. Contingent workers are a consistent part of the workforce, albeit in rather small numbers. In general, organisations profit from dealing with peaks in workload, filling knowledge gaps, implementation of new ideas and succession planning. Interestingly, we found that the benefits depend on the contingent workers' task complexity. We identified two distinct rewards: for low-level tasks, organisations mainly benefit from dealing with peaks in workload. For high-level and complex tasks, organisations take advantage of filling knowledge gaps and implementing new ideas. Even though the reduction of personnel costs seems to be a main reason to hire contingent workers, we did not find evidence that it is also the main benefit. The extent to which companies can benefit from the use of a flexible workforce depends, among other things, on the complexity of the tasks and organisational characteristics such as the culture of trust and the practice of knowledge management.

5.2 Implications

Our results indicate that professional flexible workforce management might be necessary to profit from the full potential of a flexible workforce. We highly recommend organisations to think beyond existing models and to develop an integrated view regarding HR strategies and processes for managing a blended workforce including the idea to introduce a designated "FlexManager", who is responsible for the management of a flexible workforce.

With regard to HR practices, we propose that a success factor for a flexible workforce practice resulting in benefits for both organisations and employees might be a holistic management of the blended workforce including an integrated view on workforce planning and HR processes.

Contingent employees might benefit from such an approach because it would include contingent workers in organisational processes, developing instruments for the management of contingent workers and establishing a culture and environment where contingent workers feel trusted, included and welcomed. This might also improve the employability of contingent workers.

5.3 Limitations and Future Research

There are limitations to this study that guide future research. The exploratory character of the study was important to get a very general idea about flexible workforce practices of HR professionals in Swiss organisations. However, the exploratory design is also a limitation of our study since it does not allow for the generalisability of claims. Further research would benefit from a more hypothesis-driven quantitative approach to investigate the effects of a flexible workforce management on organisational and psychological outcomes.

Second, we only focused on one of the two flexible labour utility strategies: external flexibility. Further research would benefit from also including internal flexibility and a focus on the interplay between both strategies.

In addition, we suggest further investigating and identifying indicators allowing a flexible workforce risk and opportunity assessment from both perspectives, flexible employees and organisations. A currently launched research project explores these issues in companies in the finance, health care and mobility sector.

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Sustainable Business Model Innovation for Society 5.0: Towards a Collaborative, Inter- and Transdisciplinary Approach with Students and Organizations

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Abstract. Digital transformation and sustainability are but two developments in a society 5.0 that challenge businesses to rethink their business models. Sustainable business model innovation should enable companies to operate within planetary boundaries while ensuring their long-term success. Following a design-based approach, this action-oriented research addresses how higher education institutions can offer educational initiatives that strengthen students' and organizations' capabilities for sustainable business model innovation. This paper confirms and addresses the need for more research on collaborative, inter- and transdisciplinary educational approaches for sustainable business model innovation with students and organizations.

Keywords: Sustainable Business Model Innovation, Higher Education, Know-How Transfer, Action-Oriented Learning

1 Introduction

Society 5.0 envisions a sustainable, inclusive socio-economic society powered by digital technologies [1]. The vision highlights two key developments that raise considerable challenges and opportunities for organizations: digital transformation and sustainability. Digital technologies have fundamentally changed how we work and interact, especially seen during the COVID19 pandemic [2]. However, although many positive aspects have been hailed, these changes have also raised considerable debates around their social, ethical, and political implications [3]. On the other hand, mounting concerns over environmental and social issues have argued for a monumental shift towards increasing sustainability [4,5], calling for businesses to move beyond the pursuit of

mere profit maximization. These developments have made it imperative for organizations to rethink their business models to not only ensure long-term competitiveness but also contribute to solving societal issues [6,7].

Successful business model innovation goes beyond product, service, and technological innovation to transform how business is done [6]. Within this context, the importance of sustainable business model innovation (SBMI) has increased and should enable companies to operate within planetary boundaries [5,8], increase their competitive advantage, and improve their internal capabilities for innovation and change. However, SBMI depends heavily on harnessing the collective capabilities of diverse stakeholders and the quality of local institutions and ecosystems [7]. In this line, collaborative, inter- and transdisciplinary innovation approaches have become increasingly important. This emphasizes a need for fundamental changes in existing innovation practices and may unearth organizational or cognitive barriers [9]. Furthermore, given the transformations needed to move towards true sustainability and the bounty of ethical considerations that accompany the use of digital technologies [3], a critical reflection is required on the mental models that underscore traditional "business as usual" approaches.

Current research on SBMI acknowledges a need for more research into how organizations can transition to more sustainable business models [6,7] and the appropriate tools and processes to support them [7,10]. Consequently, research in these areas has increased [6,7,11]. However, one area that remains under researched is the educational facet in supporting organizations in such transitions [12]. Higher education institutions (HEIs) can play a significant role in helping organizations meet the challenges of SBMI [13]. On the one hand, by educating responsible future leaders [14] who see business as a means to transform and serve society [15]. On the other hand, by providing spaces for creative experimentation in collaboration with industry to benefit both student learning and businesses' innovation capability [16]. Although several learning collaborations and formats between HEIs and organizations exist, only a few give specific focus to SBMI [12]. SBMI strongly calls for inter- and transdisciplinary approaches that are biased towards action and learning by doing and while the literature on *Higher Education for Sustainable Development* (HESD) contributes greatly to competences and learning methods [17,18]. What appears insufficiently addressed is research on the practical implementation thereof for SBMI.

Therefore, our action-oriented research project aims to provide practical insights on appropriate educational initiatives for collaborative, inter- and transdisciplinary SBMI with students and organizations. This research contributes to practice and the literature streams of SBMI and HESD. Spread over five phases, we investigate the formats, content, processes, and success factors of existing initiatives. With the information obtained, pilot projects are developed to experiment and unpack further insights. The remainder of this paper is structured as follows. Section 2 describes the key theoretical concepts relevant to this project. Section 3 introduces the project, the research design, and the preliminary results of the project's first phase. Section 4 concludes this paper.

2 Key Concepts

2.1 From Business Models to Sustainable Business Model Innovation

Business Models. Although *Business Models* (BM) and *Business Model Innovation* (BMI) have grown into a robust body of knowledge over the last 15 years, the theory is still in a consolidation period with some conceptual inconsistencies and ambiguity [6,19]. In essence, a business model (BM) explains how business is conducted and "describes the design or architecture of the value creation, delivery and capture mechanisms" of a firm [20 p.191]. A BM is often depicted in an overarching concept comprised of the business's different components [20-23]. The extant literature provides many representations emphasizing a lack of consensus about what a BM consists of [24]. One of the most referenced, *The Business Model Canvas* (BMC), considers nine blocks for value creation [25]. Further well-known examples include the 7-Keys model of the University of Applied Sciences Northwestern Switzerland (FHNW) [26], and Gassmann et al.'s [22] conceptualization with four central dimensions: The Customer (Who), the value proposition (What), the value chain (How), and the profit mechanism (Why). On the rise are depictions that include social and ecological considerations such as the *Sustainable Business Canvas* (SBC) [27]. A BM, however, consists not only of its components but also the linkages and interactions among them [28]. Table 1 provides a comparison of the four mentioned forms of representation and their components.

Table 1. Comparison of Selected Business Model Representations and their Key Components.

BMI **Gassmann et al.** [22]	***BMC*** **Osterwalder et al.** [25]	***7-Keys Model*** **Meyer & Tavic** [26]	***SBC*** **Tiemann & Fichter** [27]
			Vision & Mission with Social & Environmental Goals
Who?	Customers	Customers	Customers Competitors Other Stakeholders
What?	Value Proposition	Products & Services Competition	Value Proposition
How?	Sales Channels Customer Relationships	Market Development	Key Partnerships Key Activities
	Key Partners Key Activities Key Resources	Resources	Key Resources
Why?	Cost Structure Revenue Streams	Money	Cost Structure Revenue Model
		Person/Team	

Evident in Table 1 is that the focus of the first three representations remains more closely on the organization as the main object. In contrast, the SBC acknowledges the business as embedded in a bigger context, including social and ecological considerations and with broader stakeholder involvement.

Business Model Innovation. Rapid technological advances and resulting competitive pressures have pushed *Business Model Innovation* (BMI) to the top of management and academic agendas [6,29]. BMI refers to the process of altering a BM in response to internal and external incentives by developing, diversifying, acquiring, or transforming it [6, 7]. Innovating a BM differs from product or process innovation in that it significantly affects at least two dimensions [30]. BMI, according to Foss and Saebi [6], is a dynamic process that may occur in varying degrees of intensity, depending on the degree of innovation implemented, such as new to the firm or new to the market, or the extent of the changes, such as individual components or systemic/architectural structure. Successful BMI generates value for customers, various stakeholders in the ecosystem and captures value for the firm [30]. However, BMI presents a challenge for firms, and organizational or cognitive barriers may arise [9]. Organizational barriers may be linked to resource allocation, complexities surrounding BM development parallel to existing BMs, or inertia triggered by concerns about the efficacy of new BMs [9,24]. Managers' ability to imagine or identify alternative BMs, and their knowledge of the critical systems, skills, or processes, may be hindered by cognitive barriers [9,24].

Sustainable Business Model Innovation. Mounting concerns over social and environmental issues have led governments, investors, companies, and civil society's growing interest in sustainability. To the good of current and future generations, sustainability envisions a balanced convergence of economic performance, social inclusion, and environmental resilience [31].

Consequently, Sustainable Business Model Innovation (SBMI) has received increasing attention [7,32] which involves "*the analysis and planning of transformations to a more sustainable business model or from one sustainable business model to another. This comprises both the development of an entirely new business model and the transformation of an existing business model*" [7 p.409]. In this context Sustainable Business Models (SBMs) have been defined as boundary-spanning and interactive systems [10], which according to Geissdoerfer et al. [7] "*incorporate pro-active multi-stakeholder management, the creation of monetary and non-monetary value for a broad range of stakeholders and hold a long-term perspective*" [7 p.403]. SBMI, therefore, builds on traditional BMI but applies to an extended context, incorporating sustainability as guidelines for BM design, and seeks to contribute positively to the environment and society in addition to capturing economic value [19,33,34]. Several SBMIs have emerged, and a few examples include circular-, regenerative-, decarbonized-, equity-focused-, local- or degrowth-inspired BMs [35].

Companies are increasingly recognizing that sustainability can be a source of innovation and competitive advantage. Geissdoerfer et al. [7] go as far as to argue that the comprehensive advantages SBMs offer organizations will ultimately render the concept of non-sustainable BMs obsolete. The challenge, however, lies in considering a broader context and moving beyond incremental innovations such as technological innovations or operational changes that reduce cost and risk to more radical organizational, institutional, and social innovations [36]. To this end, researchers have called for more research into how organizations can transition to more SBMs [6,7] and the appropriate tools and processes to support them [7,10].

2.2 Process & Tools for Sustainable Business Model Innovation

A shared understanding of what constitutes SBMs and how they can be developed is still lacking [10]. However, in recent works, the innovation process has evolved from what was initially conceived as a linear, step-by-step process to a more dynamic and systemic process involving different iterative phases [6,10,12,36]. Characterized by some as discovery-driven, the process also emphasizes the need for experimentation and ongoing learning by doing [12,37,38] and the need for collaboration and inclusion of various actors in the business model ecosystem [10,36,39,40]. In fact, although challenging, the need for even more diverse stakeholders to come together in efficient and effective networks is seen as one of the specific necessities for SBMI [10,36]. Thereby increasing the need to use systems thinking and stakeholder discovery to expand the business canvas and better understand the broader context.

To complement the process of SBMI, the literature provides a variety of tools for analyzing and developing BMs. Prior research has emphasized their roles in creating shared conceptualizations and enabling communication between the stakeholders involved in BMI [40]. Tools can be broadly understood as techniques, methods, frameworks, and approaches that support decision-making in BMI [40] and facilitate various activities such as BM exploration, design, testing, implementation, or growth [41]. One of the most widely known and used tools is the business model canvas [23], a simple and intuitive tool used to describe and think through the different elements of a business model. With increasing importance placed on digitalization and sustainability to ensure firms' future fitness and positive contributions to society, several variations and additional tools have surfaced to focus more on SBMI. There has, however, been a lack of clarification on where existing tools for conventional BMs are adequate and where new tools are needed for embedding sustainability in BMI [42].

Nonetheless, Pieroni et al. [19] found that SBMI approaches are becoming more heterogeneous, relying on multiple theories that deviate from the more traditional view depicted in the BM canvas. Pieroni et al. [19] systematized a comprehensive collection of conceptual frameworks, methods, and tools currently available to support BMI towards sustainability. Based on Teece's [43] dynamic capabilities view, Pieroni et al. [19] differentiate the functional role of these methods and tools into ones that can be used to help identify opportunities for new BMs (sensing), be applied for designing and testing new BM concepts for sustainability (seizing) or can support experimenting, testing, and implementing the business model concepts (transforming). However, there appears to be still a lack of methods or tools for the latter "transforming" role [19], and many existing tools remain unused due to their increased complexity, resource requirements, or context-specificity [44].

Nonetheless, it can be deduced that successful SBMI requires diverse stakeholder involvement in a dynamic, iterative process that allows for experimentation and learning by doing. Therefore, the literature emphasizes tools that support organizations' dynamic capabilities to adapt and develop BMs and embed sustainability throughout the process. As an orientation, Breuer et al. [10] provide the following set (Table 2) of guiding principles and process-related criteria to inform the choice or design of processes and tools for SBMI.

Table 2. Guiding Principles & Process-Related Criteria for SBMI. Source: Breuer et al. [10].

Guiding Principles	Process-Related Criteria
Sustainability Orientation with clearly communicated vision.	**Reframing BM components** and their relations into a sustainability perspective.
Extended Value Creation beyond only for the company, customers, and shareholders.	**Context-Sensitive Modelling**, that integrates externalities in traditional BM's.
Systemic Thinking, recognizing BMs as a boundary-spanning interactive system.	**A Collaborative Modelling Process**, that involves key stakeholders into the process.
Stakeholder Integration, while recognizing their needs, interdependence, and influence.	**Managing Impacts and Outcomes** - monetary and non-monetary impacts.

Breuer et al.'s [10] guiding principles and process-related criteria compile the most relevant theoretical works in the field to set the minimum requirements for SBMs and criteria to support their development. Their work re-iterates the importance of considering the expanded context in which businesses are embedded and the integration of a wider net of stakeholders in the process of SBMI.

2.3 Recent Collaborative, Inter- & Transdisciplinary Approaches for Business Model Innovation with Students and Organizations

Collaboration between higher education institutions (HEIs) and industry is increasingly seen as a vehicle to enhance innovation. HEIs are encouraged to build partnerships and multidisciplinary innovation projects based on real-world problems to benefit both student learning and businesses' innovation capability [16]. Beyond this, attention has been given to an emerging mission for HEIs, one of co-creation for sustainability between HEIs, industry, and civil society [45]. In teaching, the concept of students engaging with organizations in action-learning projects, which allows them to work on real-world and increasingly sustainability-related challenges, is not new, and variations of these can be found in many MBA and other programs across the world. Further learning methods, such as inter-/transdisciplinary, collaborative, and problem-based learning, have received increasing attention in higher education and are believed to be fruitful for developing competences for sustainable development and entrepreneurship [18]. Table 3 provides an overview of how these methods are defined.

Given that SBM's are seen as boundary-spanning, interactive systems incorporating pro-active multi-stakeholder management [7,10] make transdisciplinary and collaborative approaches of particular interest. Furthermore, digital transformation and sustainability constitute a "wicked" problem for many organizations [46] that require different ways of understanding and (re-)solving the issues involved. Thus, calling for perspectives from different disciplines and diverse stakeholders' interests in the development process, allowing for rich combinations of otherwise disconnected pools of ideas and solutions to complex problems. Diversity seems to contribute not only to creativity phases and development but also to implementation [16].

Table 3. Teaching and Learning Methods for Sustainability Education (based on [47-48]).

Method	Definition
Action Learning	Active participation in the problematization process through research and problem solving.
Interdisciplinary Learning	Incorporating different disciplines and the expertise of multiple methods to solve a particular problem.
Transdisciplinary Learning	Aims to go beyond the concept of the academic discipline, including stakeholders like organizations, customers, and citizens.
Collaborative Learning	Refers to methods, activities, and environments where two or more learners engage in a common task.
Problem-Based Learning	A transdisciplinary, systemic approach to problems where learning is organized around societal, environmental, and economic issues both globally and locally, potentially enabling complex decision-making processes.

The call for diverse (external) stakeholder inclusion emphasizes the need to strengthen communication and participatory leadership skills to engage with diverse groups of people. The importance of collaborative and participatory leadership approaches and practices has already been emphasized for both SBMI and digital transformation processes [46,49,50]. One approach that specifically applies to this is *The Art of Hosting*, which may be seen as both inter-and transdisciplinary as it draws on different techniques and emphasizes the inclusion of diverse groups of stakeholders [51,52]. The approach offers a "space" and practice area for building participatory leadership through conversation and focuses on moving from strategic conversations to wise action and systemic change. It can be offered as a complimentary training program in which participants learn to facilitate and host conversations, challenge their thinking, stretch their imagination, cultivate creativity, and co-create interventions.

Interdisciplinary approaches are of further importance in this context as it allows for the integration of disciplines that can complement the more dynamic and systemic processes of SBMI. In this line, integrating more “designerly” approaches and creative thinking tools has increased and are said to enhance the learning experience and process [53]. One, in particular, *Design Thinking* (DT), has gained increasing popularity in the business environment [54]. DT is an approach and collection of techniques from different disciplines, which should lead to solving complex problems and developing new user-centered ideas. Design thinking includes context analysis, problem identification and framing, idea and solution generation, creative thinking, sketching and drawing, modelling and prototyping, testing, and evaluation [55]. DT provides a compelling process for idea development [56], and more research into its use to stimulate SBMI has been encouraged [54].

The increasing interest in innovation and BMI has led to several learning collaborations between HEI and organizations. These have taken the shape of curricular and extracurricular activities that include semester courses, innovation labs, summer

schools, hackathons, or workshops that bring students together to work on challenges that start-ups, SMEs, or bigger organizations face.

However, research focusing specifically on SBMI with students and organizations remains scarce [12]. SBMI strongly calls for inter- and transdisciplinary approaches that are biased towards action and learning by doing, and although a rich body of literature under the umbrella of *Higher Education for Sustainable Development* (HESD) contribute by delineating competences for sustainable development [17] and teaching and learning methods [42]. What appears insufficiently addressed is research on the practical implementation thereof for SBMI. Furthermore, approaches in practice remain fragmented and educational silos can hinder the effective collaboration needed to enable learning in a landscape of practice. Overall, despite the rapid increase in research on SBMI [6,7,11], the educational facet in building SBMI capabilities of students and supporting organization's transitions to SBMs remains under-researched [12]. Thus, emphasizing a need for more research in this area, which our action-oriented project seeks to address.

3 Exploring & Designing an Inter- & Transdisciplinary Student Think Tank for Sustainable Business Model Innovation with Organizations

3.1 Project Description and Objectives

Currently, little is known on effective educational initiatives that connect students and organizations for SBMI. Our action-oriented research project aims to gain a deeper understanding of what an appropriate educational initiative should look like to enable collaborative, inter- and transdisciplinary SBMI with students and organizations. Spread over five phases, we investigate the formats, content, processes, and success factors of existing initiatives. The information obtained will then flow into developing a pilot project, which will be launched to experiment and unpack further insights.

The project aims to develop a think tank for SBMI that will focus on connecting students from different universities and faculties with organizations in the Upper Rhein region. The think tank will provide students with a unique opportunity to explore the connection between business models, society, and the environment. Furthermore, take on real-world challenges that organizations face and co-create innovative solutions in cross-border, interdisciplinary student teams. Organizations will benefit from extended know-how, resources, and tools to identify and drive ideas and build their innovation capability. In turn, the project will provide insights into existing approaches of HEIs and how to strengthen students' and SMEs' sustainable business model innovation capability in the Upper Rhein region.

Thus, the potential value of this research is twofold. On the one hand, the results will offer practical insights and recommendations for providing education for collaborative, inter-and transdisciplinary SBMI with students and organizations, benefiting both educators and organizations. Furthermore, contribute to the literature streams of SBMI and HESD. In the long term, we hope to enhance both student's and organizations' abilities

in the region to navigate towards more sustainable practices, including ethical and responsible use of digital technologies.

3.2 Research Design

The research project is both exploratory and action-oriented. It follows a design-based research approach defined by Wang and Hannafin [57, p.6] as "*a systemic but flexible methodology aimed to improve educational practices through iterative analysis, design, development, and implementation, based on collaboration among researchers and practitioners in real-world settings, and leading to contextually-sensitive design principles and theories*". In line with our goals, the approach is seen as suitable for advancing both theory and practice [58]. As illustrated in Figure 1, our project is structured over five phases and builds on McKenney & Reeves's [58] core phases of educational design research. This includes 1) analysis and exploration, 2) design and construction, and 3) evaluation and reflection, to move towards implementation and the provision of both practical and theoretical insights.

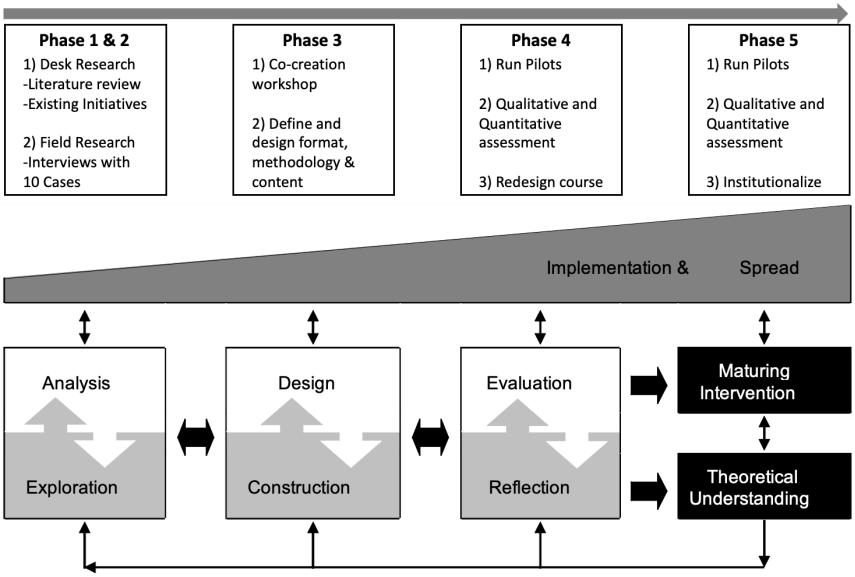

Fig. 1. Research Model. Adapted from McKenney & Reeves [58].

Phase 1 of the project consisted of desk research. Firstly, to review the extant literature on the topic to better define and delimit the key aspects relevant for the project. Secondly, to gain practical examples of similar initiatives focused on BMI or SBMI with students and organizations. The aim was to gain an overview of existing formats, approaches, methodologies, and tools in practice. Initiatives were selected based on their

focus on (sustainable) business model innovation and connecting students with organizations. Another focus was placed on collaborative, action-learning, and inter-and transdisciplinary approaches. The preliminary findings of this phase are presented in Section 3.3.

Phase 2 of the project is currently running and involves field research. From the initiatives identified in phase 1, ten cases situated in Europe and the USA are studied. Each case consists of a "good practice" example, which can be understood as cases that were selected based on how closely their offering related to collaborative, inter- and transdisciplinary SBMI with students and organizations and the level of innovativeness of their offering. The level of innovativeness can be understood as offerings that move beyond education in the classic sense towards innovative inter- and transdisciplinary approaches, formats, methods, and tools. Within each case, the person responsible for the initiative is interviewed. Furthermore, the aim is to engage additional interview partners to gather different perspectives (participating organizations and students). In-depth semi-structured interviews will be conducted, transcribed, coded, and analyzed using Atlas.ti software. This phase aims to provide deeper insights into the approaches, methods, and tools used and the success factor and outcomes of the initiatives.

Phase 3 will involve the co-creation and development of a set of approaches and tools for educational pilot projects for SBMI with students and organizations. This phase strongly builds on co-creation with various stakeholders including project partners, students, and lecturers from different faculties of participating educational institutions and a selection of business practitioners. The phase aims to define the overall approach and a variety of formats that can be experimented with as well as methodologies, and content.

Phase 4 involves the launch of pilot projects, which will include different HEIs and organizations in the Upper Rhine region. This phase will aim to experiment with and test the developed concept. The phase will include qualitative and quantitative data collection in the forms of interviews, observations, and surveys to aid in assessing and redesigning the offering.

Phase 5 will utilize the insights gained from the previous phases to evaluate and improve the concept. Furthermore, to assist in launching further pilots in varying forms for further development. The project aims to be institutionalized into formal structures as an ongoing experimentation platform and think tank for innovative inter- and transdisciplinary action-learning for SBMI.

The project is ongoing and currently in Phase 2. The following section provides insights into the learnings derived from Phase 1.

3.3 Preliminary Results

This section summarizes the preliminary results of phase one of this ongoing action-oriented research project [59]. Phase 1 included desk research to gain practical examples of similar initiatives focused on BMI or SBMI with students and organizations. The aim was to gain an overview of existing formats, approaches, methodologies, and tools in practice.

In total, 120 initiatives were identified that matched aspects of the criteria laid out in Section 3.2. The initiatives were then narrowed down to a selection of 59 initiatives that either met the criteria more closely or showed particularly promising approaches and methods or novel formats. These initiatives were then examined more closely to conclude their overall focus, their most common target groups, the types and duration of their offering, and their methods, approaches, and tools.

The overall findings from these 59 initiatives show that although many initiatives focus on innovation, sustainability, and business model optimization in a general sense, only a few (6) are focused explicitly on SBMI. Furthermore, when SBMI is included, it is often combined with other innovation and business improvement objectives. Most of the initiatives are targeted at master level students, although some are open to a mix of Bachelor and Master students, and five initiatives also included Ph.D. students. More than half of the initiatives were open to students from different faculties. Few initiatives focus on SMEs, while the majority focus either on large companies or a mix of organization types and industries. Only 6 initiatives focused specifically on start-ups were included in the selection as these were otherwise considered beyond the scope of our research. In line with the objectives of our project, most of the initiatives are university-based and connect students with organizations. Some other combinations were found, where students rather independently provide consultancy-like services to organizations or where universities provide services directly to organizations.

More than half of the offerings consist of semester courses, followed by mixed offers of workshops that last either a few days or up to 2 weeks. Some initiatives were found to offer independent courses that vary between 4 weeks and 10 months in length. All initiatives include some form of collaborative action or project-based learning methods in line with the selection criteria. Most of the initiatives are inter- and transdisciplinary in nature, and 23 initiatives also include design approaches and creative thinking tools. Many of the initiatives do not specify the tools utilized. Thus, it was only possible to identify 9 initiatives that explicitly mention the use of SBMI tools. The majority appear to work with classic BMI tools, such as the Business Model Canvas and other creative thinking tools. About 13 of the initiatives were specifically design-oriented and used only design-related tools.

The initial findings of this research appear to confirm a lack of initiatives (beyond those focused on start-ups) that focus on collaborative SBMI with students and organizations [12]. Promisingly, however, there appears to be an overall trend towards inter- and transdisciplinary approaches that bring students from different faculties together with organizations and utilize a mixture of methods and tools from various disciplines. In particular, the inclusion of design approaches and creative thinking tools by almost a third of the initiatives appears to reflect its increase in popularity in the literature [53,54]. The low use of SBMI tools would support the literature on finding that many existing tools remain unused [44]. However, since many initiatives do not specify the tools they use, this remains inconclusive. The next phase of our project work will more intensively research a selection of cases to gain deeper insights into the approaches, methods, and tools used and the success factors and outcomes of the initiatives.

4 Conclusion

Sustainability and digital transformation are but two developments that will challenge organizations to rethink their business models in a Society 5.0. In this line, the importance of sustainable business model innovation (SBMI) has increased and should enable organizations to operate within planetary boundaries while ensuring their long-term success. Successful SBMI requires diverse stakeholder engagement, integrating multiple disciplines, and quality local institutions and ecosystems. Thus, emphasizing the importance of collaborative, inter- and transdisciplinary innovation approaches. However, this may pose a considerable challenge for organizations and future leaders, requiring changes in their current practices and ways of thinking. Higher education institutions can play a major role in helping organizations meet the challenges of SBMI. Yet, research focusing specifically on SBMI with students and organizations and its practical implementation remain scarce.

This paper confirms and addresses the need for more research on appropriate educational initiatives for collaborative, inter-and transdisciplinary SBMI with students and organizations. The initial findings from the first phase of this ongoing action-oriented research project show that although many educational initiatives are applying collaborative inter-and transdisciplinary approaches that, as in the literature, only a few explicitly focus on SBMI with students and organizations. The findings also support the increased popularity of design approaches and creative thinking tools and emphasize the use of systems thinking and stakeholder discovery to understand the broader context better. However, several questions remain regarding how these approaches and tools are implemented and how they can be combined with SBMI tools. The remainder of this ongoing research project will continue to address these questions, among others, to contribute both practical and theoretical insights.

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The Adoption of Generalized Audit Software (GAS) and Digital Analytics by Shariah Auditors in Islamic Banks

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Abstract

This paper identifies the adoption of information systems (IS) in the form of generalized audit software (GAS) and digital analytics by Shariah auditors (SAR) in Islamic banks (IBs). To explore further, this paper identifies this practice among four types of banking groups, namely full-fledged Islamic banks (FFIB), Islamic banking subsidiaries (IBS), development financial institutions (DFI), and Islamic windows (IW). In attaining its objective, this study employs a qualitative method by utilizing semi-structured interviews with six (6) key individuals in Malaysian IBs. Our findings support the notion that most SARs adopt and use GAS in their audit execution. Interestingly, few of them use digital analytics in conducting their audit assignments. This digital analytics application will undoubtedly help SAR seek the Shariah non-compliance (SNC) cases effectively. The samples selected by GAS would be much bigger compared to manual audit exercise, which depends on few selected samples only. However, there is an argument that the audit software application is not enough since SAR must pay visit physically to their auditee's premises. Finally, this study suggests that there should be some training for the SARs, especially regarding the GAS application, to detect the SNCs thoroughly in IFIs operations. Eventually, GAS can assist SAR in mitigating SNC cases while strengthening the public confidence and achieving *Maqasid As Shariah.*

Keywords: *Shariah auditor, GAS, digital analytics, IS Applications, Islamic banks.*

1 Introduction

In general, auditors use generalized audit software or (GAS) as tools to automate various audit activities. Accounting data auditing is likely to be computerized since most accounting transactions are also computerized. Despite the fact that GAS is the most common of the computer-assisted audit tools and techniques (CAATTs), studies indicate that it is not universally used by internal auditors (Kent and Ahmi, 2013). Thus, this paper intends to explore the adoption of GAS by SAR in the IBs. Most other GAS studies have looked at regular internal and external auditors, but this paper focuses on SAR in IB.

According to Singleton (2006), more than 60% of all frauds are discovered due to a tip or by accident. Thus, using GAS to build a cornucopia of automated anti-fraud audit procedures that are run routinely against corporate databases is a space for more aggressive anti-fraud programs. Because of the design of computer-based accounting systems, auditors can use the audit client business's computer, or their own, as an audit tool to aid them in their audit procedures (ACCA, 2016). Accordingly, the extent to which an auditor may choose between using GAS and manual techniques on a specific audit engagement is determined by many factors. Those factors, among others, are the feasibility of conducting manual testing, the cost-effectiveness of using GAS, the availability of audit time, the availability of the audit client's computer facility, the level of audit experience and expertise in using a specific GAS, the level of GAS carried out by the audit client's internal audit function and the extent to which the external auditor can rely on this work.

In the Islamic banking environment, SAR assists in developing Islamic banks' (IBs) work (Khalid, Haron, & Masron, 2018). However, there is a relative lack of research on adopting the GAS among SAR in the IBs. Likewise, in IBs, there is a need for SAR to leverage on the GAS to support the internal control mechanism and monitoring system while strengthening the internal auditing functions. This situation will eventually support SAR in accomplishing the organization's objective (Abdul Wahab & Abdul Rahman, 2011). This issue definitely triggers the need of full adoption of GAS in IBs.

On the contrary, the lack of GAS adoption in IBs might create problems in audit execution. If IBs through its governance mechanism such as Shariah audit does not adopt GAS in their audit execution, they might fail to supervise the internal control and enhance the banks' lines of defense effectively. Thus, the likelihood of Shariah non-compliance (SNC) cases to happen is very high (Lahsasna, 2014).

Consequently, the SNC cases' presence may deteriorate the reputation of IBs and may weaken the confidence of customers, depositors, shareholders, and other stakeholders towards the banks (Dusuki, 2011; Shafii, Salleh, & Shahwan, 2010).

Considering the rapid growth of the banking industry and the strict consequences for the SNC as specified in the Islamic Financial Services Act (IFSA, 2013), it is indispensable for the IBs to have a proper 'check and balance' mechanism (Yaacob & Donglah, 2012). Undeniably, this mechanism is vital specifically for the SAR and for Islamic finance's sustainability in general. Thus, the investigation of GAS adoption by SAR in the IBs as undertaken in this study could significantly contribute to the literature.

The following section will review prior literature and a debate on the significance of GAS in the audit execution of SAR in the Islamic banking industry. Then, the paper describes a research methodology, and in the next section, the paper provides some analyses into the GAS adoption by SAR in the IBs. Finally, the conclusion is drawn by emphasizing the significant issues related to this study.

2 Literature Review

There is a wealth of literature concerning the adoption of accounting software either by the public sector or private sectors. However, the literature explaining the adoption and utilization of audit software is considered limited. However, some studies report the extent of the usage of GAS among external auditors. For instance, Kent and Ahmi (2013) found that audit firms in the United Kingdom use GAS at a shallow rate. Owing to the perceived restricted advantage of using GAS for auditing small clients, approximately 73% of external auditors do not use it. Although some respondents acknowledged the benefits of GAS, they were turned off by what they perceived to be high implementation costs, a lengthy learning curve, an adoption process, and a lack of ease of use. Thus, they preferred to use conventional manual auditing methods.

In another study, Van der Nest, Smidt, and Lubbe (2018) compare the current practices of internal audit functions regarding the use of GAS in the locally controlled South African banking industry to a benchmark developed from recognized data analytic maturity models. Findings from the study reveal that despite the accelerating adoption of information technology (IT) and the generation of big data within organizations, the use of GAS by internal audit functions is still at a relatively low level of maturity. Given that the world, particularly from a business perspective, is now fully immersed in a technological-driven economic outlook. This article's empirical results also confirm that the maturity of GAS use by internal auditors employed by locally controlled South African banks is still lower than predicted.

On the same ground, Smidt, Steenkamp, Ahmi, Van der Nest, and Lubbe (2021) examine the use of GAS as a data analytics tool by internal audit functions in Australia. From a total research population of 322 chief audit executives (CAE) of internal audit functions of organizations registered members of the IIA-Australia, 50 online questionnaires were returned. The study's findings can be used as a benchmark to determine if CAEs are up to date on current best practices in the field of technology-based tools and techniques for control tests.

Adamyk, Adamyk, and Khorunzhak (2018) investigate the auditing order and methodology for computer accounting software (CAS). The findings from the study reveal that software auditing should be conducted separately for each of its elements. The database management system (DBMS) and the application software enabling accountancy automation are the CAS software's functional portions. Techniques like general evaluation and subject check of the embedded algorithms of information processing are used for auditing as the first component section. However, if the enterprise accounting strategy changes, this would prevent mistakes.

In a recent study by Bradford, Henderson, Baxter, and Navarro (2020), they examine auditors' perceptions of the relationship between audit benefits and GAS use. The partial least squares approach analyzes survey data from 188 existing GAS consumers who are financial and IT auditors. The study's findings uncover that the only significant predictor of GAS's information quality for financial auditors in detecting material misstatements antecedent. Meanwhile, detecting monitoring deficiencies and fraud has a considerable effect on information quality for IT auditors. Information quality affects both financial and non-financial auditors' use. Only IT auditors are affected by system quality, and neither form of the auditor is affected by GAS use. The use of GAS by financial auditors is affected by service quality, but not by IT auditors. Service quality has no impact on GAS satisfaction for either party, and GAS usage and satisfaction increase audit benefits expectations.

However, as far as the researcher is concerned, the study concerning the adoption of GAS among the SAR in the IBs is limited due to the nature of the study's field. However, the issue is vital because

SAR plays its roles and responsibilities as the third line of defense that ultimately requires the effective tools, techniques, and mechanisms to identify the misstatement, fraud, errors, and SNC in the IBs.

3 Methodology

3.1 The Process of Developing the Research Instrument

This main objective of this paper is to ascertain the adoption of GAS by SAR in Islamic banks based on practitioners' views and experiences. However, before data could be collected, the study has developed the research instrument based on few stages as presented in the Figure 1 below:

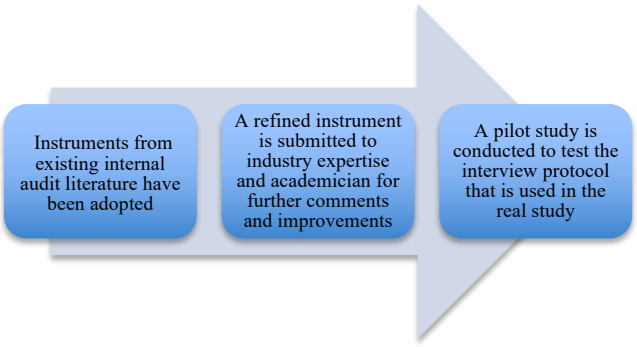

Fig. 1. The Process of Developing the Research Instrument

As illustrated in Figure 1 above, in the first stage of the process, a few instruments from the internal audit literature have been adapted and fulfilled this study's objectives. Second, the developed interview questions have been submitted to expertise scholar and industry's practitioner in the Shariah audit area as a subject matter expert. Finally, to validate the final set of interview protocol, the researcher conducts a pilot study with one of the Head of Shariah audit in IB. This pilot study is conducted before pursuing a real study to test and construct the effectiveness of the research tool (Marican, 2005).

3.2 Data Collection Method and Group of Respondents

Six (6) semi-structured interviews have been conducted with interviewees from four (4) types of IBs, namely full-fledged Islamic banks (FFIB), Islamic banking subsidiaries (IBS), development financial institutions (DFI), and Islamic window (IW). FFIB refers to either local or international banks that only offer Islamic banking products or services. Their operation is ruled by the Islamic Financial Services Act (IFSA 2013). Besides, IBS is a conventional bank with Islamic banking subsidiaries whereby they are governed by IFSA 2013 and the Financial Services Act 2013 (FSA 2013). Meanwhile, DFIs refer to specialized financial institutions established by Malaysia's government to establish and stimulate important sectors to achieve the objectives of the country's socioeconomics by offering Islamic products and services. Lastly, IW is a commercial bank given Bank Negara Malaysia's license to provide Islamic banking products and services. Like IBS, IW's operation is also administrated by the IFSA 2013 and FSA 2013 in their business operation (Bank Negara Malaysia, 2015).

3.3 Sampling Procedures

The selection of interviewee is based on purposive sampling. Even though respondents' sample size is relatively small, it is considered normal in a qualitative study because they are selected based on the criteria to provide valuable information on the phenomenon under investigation. (Creswell & Poth, 2018). The Shariah auditors' and Head of Shariah auditors' mix provides fruitful details about GAS use in Shariah audit practice (Mohd Ali, Mohamed, Shahimi, & Shafii, 2015). On top of that, perceptions from other relevant interviewees other than SAR, such as from Chief Shariah officer, are also pertinent to produce a robust and unbiased result.

3.4 Establishing Reliability and Validity

In developing the attributes of reliability and validity while at the same time minimizing risky in committing mistakes in this study, the researcher has employed few strategies as proposed by Creswell (2014) and Lietz, Langer, & Furman, (2006). These strategies are field notes, respondents' confirmation, and pilot interviews.

According to Bogdan and Biklen (2007), the high level of reliability in qualitative studies can also be accomplished by having rigorous data accumulation or systematic collection in the field. Effort and initiative that involves fieldwork such as appointments, official interviews, unofficial interviews, observations, and accumulation of documents will also enhance the reliability. For the purpose of this study, the researcher uses a small notebook to write down all activities that occur in the field. This note is transferred into the computer and saved accordingly for reference.

In addition, verification from respondents regarding the interview's data or sometimes known as member's checking, is a transferring procedure of validity from the researcher to the respondents (Mulhall, 2003). However, the current study does not receive verification satisfactorily due to low responses or inadequate feedback from the interviewees. Ironically, only two out of nine interviewees have verified the interview text and provide some suggestions for improvement. Most probably, all of them are busy with their working tasks, and they feel that they have contributed already by spending much time with the researcher during the previous interview sessions.

Finally, a pilot study is essential to emphasize the research instrument's development, the feasibility of the actual research, the suitability of the research design, sampling technique, data analysis technique, and the research questions' suitability (Neuman, 2014; Gay, Mills, & Airasian, 2012). This method, in turn, will increase the reliability of the data. The purpose of this pilot study is also to identify the plausible problems that might be faced by the researcher during the actual interviews soon.

3.5 Data Analysis and the Application of CAQDAS

Before the analysis can be performed, the verbatim transcription was accomplished for all interview sessions by employing the Computer Assisted Qualitative Design Analysis Software (CAQDAS), namely Atlas.ti version 8.0. This software is used to facilitate the process of transcribing the interview and data coding. To keep the data's confidentiality, the respondents were coded based on group and position types. For instance, HSA-FFIB will be referring to the Head of Shariah Audit from full-fledged Islamic Bank, without explicitly mentioning the institution's name. Finally, the study comes out with the list of the interviewees as presented in Table 1 below:

Table 1. Interviewee for the Study

Types of Group	Position	Respondent Code
Full-fledged Islamic Banks (FFIB)	Chief Shariah Officer	CSO-FFIB
	Head of Shariah Audit	HSA-FFIB
Islamic Banking Subsidiaries (IBS)	Head of Islamic Banking Audit	HIBA-IBS
	Senior Director of Islamic Business Unit	SDIBU-IBS
Development Financial Institutions (DFI)	Head of Shariah Audit	HSA-DFI
Islamic Windows (IW)	Head of Shariah Audit	HSA-IW

4 Findings and Discussions

4.1 The adoption of GAS by SAR

The series of interviews have provided fruitful information on the adoption of GAS by the SAR in the IBs. Some interviewees argued that the Shariah audit is technology savvy because they claim that SAR employs the latest software or IS while executing the auditing tasks. One of the interviewees from IBSs claims that:

"…, For Shariah audit, we do have IIA guideline. Based on this IIA, they encourage us to use T-mate and ACL. We use that as part of our technology to do sampling and to find exceptions on Shariah…" (HIBA-IBS).

The above argument is also supported by the Head of Shariah audit from DFI. He disputes that the employment of technology and software will ease and expedite the ISA work and eventually will enhance the ISA effectiveness as he opines:
"…There must be an efficient system since this audit system is vital. The most commonly used by the internal auditors is ACL Solution (Audit Management and Analytics). By employing this software, it is easy for us to get a sample. We can check what we want since its features help a lot. Our work will also be fast, effective, and efficient..." (HSA-DFI).

On the same ground, another interviewee supports this view by contending that the GAS assists them in finding the proper sample-based needs of users as she remarks:
"…There should be a proper system because the system is essential. The most common use in the audit field is ACL Solution (Audit Management and Analytics). Because it is easy for us to get a sample based on its features, we can check what we want…(HSA-FFIB).

Similarly, HSA-IW expresses his satisfaction with the adoption of GAS because of its functions in assisting the SAR's work. He disputes that:
"...GAS helps auditors a lot. Even audit work would be smoothly executed. Our work is effective and efficient…" (HSA-IW).

However, the above findings are contradict with the study conducted by Debreceny, Lee, Neo, and Shuling (2015), whereby they found that internal auditors in their study perceive GAS primarily as a tool for special investigations rather than as a foundation for their regular audit work. The most plausible reason behind this argument is that the development and application of GAS is significantly increase across the banking sector and it has been widely used by financial institutions including IBs.

In a nutshell, the adoption of GAS in the Shariah audit procedure and execution helps SAR in obtaining the needed audit sample as they expected. The adoption of GAS significantly ease and expedite the ISA work and ultimately will enhance the ISA's effectiveness.

4.2 The Application of Digital Analytics

Another exciting issue discussed by the interviewee relates to the significance of digital analytics in the Shariah audit procedure. SDIBU-IBS highlighting the implementation of digital analytics has an impact most on their working papers, and audit works have been changed from manual-based to automated-based as she mentions:
"…Previously, all our working papers are manual-based. Now, approximately 70% of our jobs are all automated. However, we still have to use human judgment when it comes to assessing control…" (SDIBU-IBS).

In line with the above argument, De Santis & D'Onza (2021) contend that big data and data analytics (BDA) is used to complement traditional audit procedures. In fact, HSA-FFIB supports this notion by arguing that after the application of the digital analytics, the audit judgment is more accurate since the SAR could increase the sample volume as she remarks:
"…Frankly, digital analytics solves many things. We try to explore as much as possible where we can AI (artificial intelligence) everything. The cover is much more in-depth because previously, the sample that we took maybe like 25 or up to 30 samples, but now the sample that we took is more than that..." (HSA-FFIB).

On a similar vein, HSA-IW contends that there is no sample in the digital analytics case because all of the data are considered as their samples as he asserts:
"…Sometimes, we run half a million of data. Now, there is no sample; instead, all of them are our samples…" (HSA-IW).

Interestingly, through digital analytics, the SAR can detect fraud and mismanagement much better as compared to manual audit exercise as he signifies:
"…Using digital analytics, we manage to discover very wrongly allocated funds, participants raise funds, and participant investment funds involving half of a million. Of course, we get the data through data analytics. So, we cannot depend on the manual. If we go by manual checking, we will not get much. Thus, we appreciate technology (digital analytics) very much to assist us in our audit work…" (HIBA-IBS).

However, a finding from Eilifsen, Kinserdal, Messier, & McKee (2019) shows that ADA (Audit Data Analytics) is relatively minimal, and it is uncommon for organizations to use more 'complex' ADA. More ADA is used for clients with integrated ERP / IT systems and newly issued audit assignments.

On the contrary, CSO-FFIB argues that even though software application for audit is paramount, the SAR still needs to visit and examine the locality of the auditees themselves as he affirms:

"…I am not very picky on this software element as auditing still requires a physical visit. Maybe this software is more important to finance for a consolidated report or risk management so that the process of escalation of risk is happening faster and based on real-time…" (CSO-FFIB).

A similar view has been highlighted by SC-DFI whereby she asserts that the management should consider the cost-benefit analysis in implementing the audit system so that the benefits received should outweigh the cost incurred as she contemplates:

"…For this audit, more importantly, we try to implement the best practices. If the software is just used to assist in producing the report, it is not critical; that is my personal view. Thus, not everything should be automated, and even if automation will increase the cost than the benefit received, it is not worth..." (SC-DFI).

HSA-DFI has stressed a similar tone. He argues that the implementation and adoption of GAS and data analytics depend on the management's support. If SAR wants to employ this system, the management has to leverage the system and allocate the budget adequately to install and maintain it in the long run.

In a nutshell, the findings discovered that most of the interviewees acknowledge the benefits of adopting GAS and digital analytics. Even though there are few opinions against this adoption, their benefits outweigh its deficiencies. However, the IBs need to provide proper training for their staff. Hence, as Ayedh, Mahyudin, Abdul Samat, & Muhamad Isa (2019) suggest, IBs should provide their team with essential IT and IS knowledge, including responsibility for Shariah's functions (i.e., Shariah audit, Shariah review, and Shariah risk management). Management should also suggest regular training for IFI staff, covering the information system and Shariah compliance problems.

5 Conclusion

This paper attempts to identify the adoption of GAS by SAR in IBs. Our findings support the notion that most SARs adopt and use GAS in their audit execution. Interestingly, few of them use digital analytics in conducting their audit assignments. This digital analytics application will undoubtedly help SAR seek the Shariah non-compliance (SNC) cases effectively. The samples selected by GAS would be much bigger compared to manual audit exercise, which depends on few selected samples only. However, there is an argument that the audit software application is not enough since SAR must pay visit physically to their auditee's premises. Finally, this study suggests that there should be some training for the SARs, especially regarding the GAS application, to detect the SNCs thoroughly in IFIs operations. Eventually, GAS can assist SAR in mitigating SNC cases while strengthening the public confidence and achieving *Maqasid As Shariah.*

The results offered in this study have specific implications for other Islamic jurisdictions around the globe that have a similar setting as Malaysia. Thus, this study provides a significant contribution to issues of the adoption of GAS in IBs. Besides, even though there are limited respondents through interviews, this study explores and elaborates on the respective matters. It also apprehends thoughts and intentions that are difficult to be observed using other methods (Creswell & Poth, 2018).

Like other empirical research, this study also has its limitations. First, not all the essential vital persons in Islamic banks were eager to share their valuable experience with us due to time constraints. Second, interviewees consist of only six (6) members, namely Shariah auditors, Heads of Shariah audit, Shariah Committee member, and Chief Shariah officer. The small interviewees' size can disputably limit the depth of discussions on the relevant issues. Future research could be conducted to capture more data from other experts like regulators and external auditors.

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