MODEL FOR TECHNOLOGY ADOPTION SUPPORTING SYSTEM

Petko Ruskov
FMI, Sofia University, , e-mail: petkor@fmi.uni-sofia.bg

Sia Tsolova
FMI, Sofia University, e-mail: siyat@fmi.uni-sofia.bg

Stoyan Panov
FMI, Sofia University, e-mail: stpanov@gmail.com

Abstract

Purpose: to present model for technology adoption supporting system, based on ecosystem, technology assessment and technology adoption specifics. Methodology/approach: the paper is developed according a classical methodology for research and analysis and design of a model for technology adoption supporting system. Findings: there is a high need for future development and improvement of the systems, providing supportive information for the Bulgarian innovative and entrepreneurial ecosystem. Practical implications: the described model of technology adoption supporting system is going to be a key guideline for future activities. Originality/value: the presented model of technology adoption supporting system integrates different existing pieces for technology transfer evaluation by using process approach.

Keywords: start-ups, technology assessment, technology adoption

"Technology is like fish.
The longer it stays on the shelf,
the less desirable it becomes"
Andrew Heller, IBM

INTRODUCTION

In today's times of Internet and Globalization, knowledge is growing dynamically at very high speed in all areas. In the sphere of innovations and technology entrepreneurship we have a freedom of tacit knowledge and practices. From other side a part of information is structured in explicit knowledge and processes. To reduce the risk in decision making in the field of technology entrepreneurship we need explicit information, gathered in structured data systems. Most of the information in the different communities spread amongst the world is tacit and is connected with their economic, cultural and technological specifics. Based on these specifics they create IT systems, supporting the decision making process. This is of crucial importance for technological startups around the world. The world is experiencing a boom in interest around start-ups [1, 2]. Frequently the key to success for a technology start-up is to validate the technology and the needs of the targeted customer. Technology adoption and appraisal of start-ups is vital for all stakeholders, if they want to increase their chances of success. This essential validation data cannot be found in participating at different type of workshops. Entrepreneurial teams must use a proven scientific method or system to assess currently growth potential of the technology and measure risk of product development hypotheses of their potential customers. There is a big risk to possibly get stuck in the "Valley of Death" area – figure 1 and figure 2 [3, 18]. It refers to the time when the start-up runs out of funds and creates a negative cash flow before a steady stream of revenues can be established.

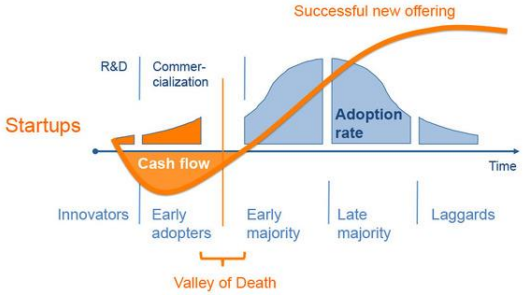

Fig.1*. Start-ups Cash flow*

The financing valley of death commonly tests the commitment, determination, and problem solving ability of every entrepreneurial team. During that time when the start-up team produce remarkable value out of nothing.

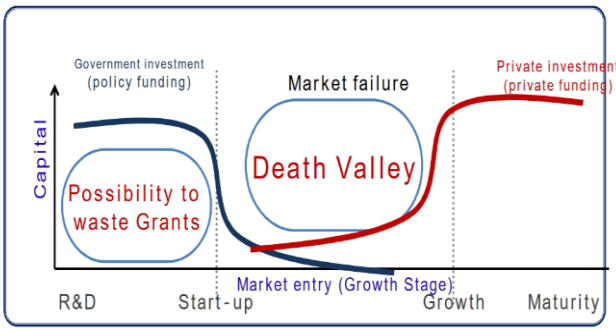

Fig. 2*. Valley of Death in Start-ups development*

Efforts at that time really separate the true entrepreneurs from the imitators. Usually entrepreneurial team needs outside financial venture support from angels, incubator, accelerators or government funds to cross the "death valley". Today new, agile and competent venture funds use new business models. They change the exit strategy from an IPO (Initial public offering) to acquire (mostly technology disruptive start-ups) – figure 3.

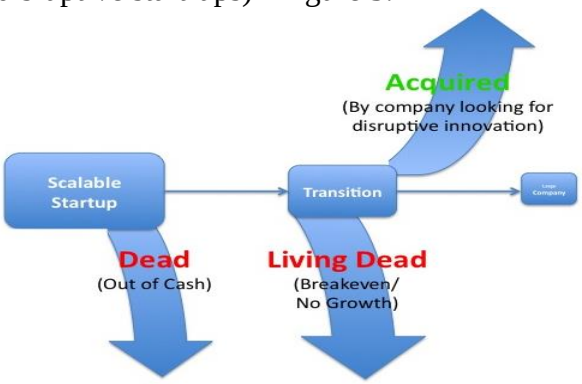

Fig. 3*: Startup Lifecycle Today*

In startup financing, the term valley of death relates to the period of time with negative cash flows, usually from the seed stage to the generation of positive net income. As companies with negative cash flows need external financing to cover expenses, failing to obtain such leads to inevitable failure.

To bridge the valley of death, various financial supporters step in. In the initial stage, these are likely to be friends and family, followed by angel investors, why at the later stages venture capitalists step forward – figure 4.

Often startups with good chances fail to get access to external capital. On the other side start-ups with less prospects obtain financing, but fall through afterwards. This suggests that the financing decisions may well not asses the commercialization potential of technology: (i) friends and family are emotionally driven (ii) grants, foundations and state programs have flawed selection criteria (iii) angel investors and venture capitalists often delegate the analysis to the entrepreneurs, partly because they cannot evaluate the implications of the technology.

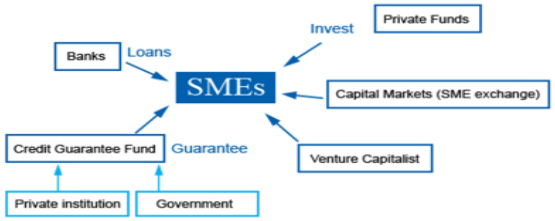

Fig. 4*: Technology financing landscape*

A closer look into decision making mechanism reveals that there is not sufficient information supporting the decision making process, and also that there is not available system, developed to support this process with the participation of all stakeholders.

A holistic model that could assess the profitability and the marketability of technology would fill in the gap and contribute to the more efficient allocation of capital. Such method, framework and IT system would reduce the burden on entrepreneurs and provide robust decision-making foundation for angel investors and venture capitalists.

The goal of the paper is to: 1) present a technology assessment and technology adoption current state, 2) describe stakeholder's involvement on the adoption lifecycle phases, and 3) framework our model for technology assessment system.

METHODOLOGY AND RESEARCH DESIGN

Starting point of our research is a literature review and an Internet key-word search in order to locate possible best practices and case studies in Europe, Asia and North America. After that the authors synthesize a methodology successfully applied in South Korea. Then will continue to mix methods and observation techniques to transform them into tangible processes, metrics and results. The authors also

use the concept of stakeholder theory to analyze the role of stakeholders during the technology adoption process with affections to our perceptions on the influencing factors.
An on-line Google study (October 7th, 2016) on the results has shown the following results:

Table 1. *Summary of the search results by search term (in thousands)*

	Technology assessment	Technology appraisal	Technology valuation	Technology evaluation	Technology adoption
Google search	5210	224	29,2	493	443
Google scholar	899	16,5	1,4	62,7	192

From the implemented research it is clear that the fields of "Technology Assessment" and "Technology Adoption" attract the highest levels of interest for all stakeholders.

EXISTING SOLUTIONS AND NEED FOR TECHNOLOGY ASSESSMENT AND TECHNOLOGY ADOPTION MODEL

Business leaders worldwide are concerned about innovative product or services entering their market. Proactive technology adoption is a key to product or service differentiation. Now and again a wide range of innovative technologies can make it harder to identify true breakthrough technologies. Many efforts at innovation and business model innovation fail. To change that, executives need to understand and predict how business models develop through predictable stages over time — and then apply that understanding to key decisions about new business models. The role of all stakeholders at the adoption process, each with detailed domain knowledge and expertise, are critical.
Many of the efforts involve implementing new information systems and information technology (IS/IT) for integrating existing systems to supply improved services. That are vital to the success of developments. A qualitative multiple case study approach is adopted to empirically highlight the different categories of stakeholders involved in the TIS adoption process, the dynamic nature and importance of their role, and why their domain knowledge and expertise are vital for IS/IT projects – figure 5.

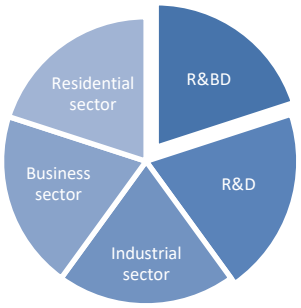

Fig. 5*: Stakeholders in the process*

Main stakeholders and their roles in the process are:
R&D is a source of new knowledge presented by academic and research institutions. R&D generate ideas in large quantities and a future investigation and development is needed to attract a future investment.
R&BD presents the Research and Business Development process of a technological innovation. Incubators and Accelerators select the most promising ideas and prototypes. A business and financial analysis is further needed in order to support the selection process.
Industrial sector use processes that produce materials and information and supports the development of prototypes and pilot product or service.
Business sector has storefronts that offer goods and services to customers, directly implementing the process of commercialization.
Residential sector represents communities that offer lessons learned and best practices and evaluates the value of the products and services on the market. Knowing the customers is the most important of startup success, we need to learn about their problems and needs.
There are many risks and uncertainties during this cycle which are top priority for all stakeholders. Mostly it is local ecosystem, which prove the final results – figure 6.

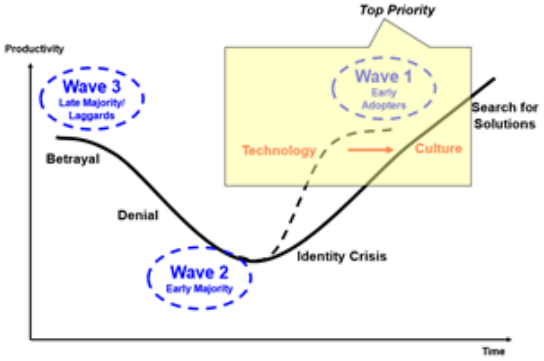

Fig. 6*: Learnings from technology adoption [16]*

A functional model of active/creative intermediary (broker) for the transfer of research results from publicly funded research organizations to other spheres of public activity is described in PhD thesis [17]. The implemented model leads to improved innovation processes and supports the technology transfer stage through virtual broker at stage R&D and R&BD. In order to support the entire process of technology commercialization we suggest inclusion of all stakeholders in the system and inclusion of technology evaluation processes in the system.

State of the art of technology assessment has been investigated from many authors [4, 5, 6, 7, 8]. The results are described in a previous article of the authors [19, 20]. We have found only one generic method that systematically assesses the economic and technical aspects of technology. The model has been developed by the Korean government funded organization The Korea Technology Credit Guarantee Fund (KOTEC) [9]. In 2005 KOTEC introduced KTRS (KOTEC Technology Rating System). It applies a scoring model to assess technology in four categories - management competence, technical feasibility, marketability and business feasibility and profitability.

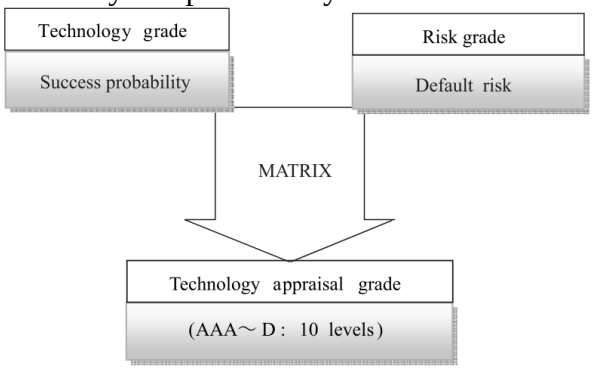

Fig. 7: *System of technology appraisal model [10]*

KOTEC Model is technology assessment is presented at figure 7.

Our team published a reverse engineering model of startup technology assessment [20]. We use a reverse innovation and engineering approach to discover and learn from KOTEC model and product and hope to design a new, specific for Bulgarian ecosystem technology appraisal model and advances in know-how [12,13]. KOTEC technology rating system provides a systematic approach to appraising technology. Since it proved successful in Korea, it is worth trying testing it in local environment. Despite the available academic research, the model is proprietory and only little is known about its mechanism. Most of the public information gives an abstract overview, but the specifics remain hidden. Although the KOTEC's model is hidden, we will use the available information to reverse engineer it. The classification hierarchy of the grading system outlined in the previous section is a good starting point for our endeavour and design.

The Bulgarian model is made up also of the parts: technology grading and financial risk assessment.

The first part is illustrated in figure 6. The model will assess companies on 34 factors. The factors will be grouped in four major categories as outlined in the previous section: management capability, technology, marketability and profitability.

The collected information will be then validaded and its relevance will be evaulated. Finally the technology grade will be calculated as a wegited averge of the input factors.

We will also use AHP method to calculate the technology grade.

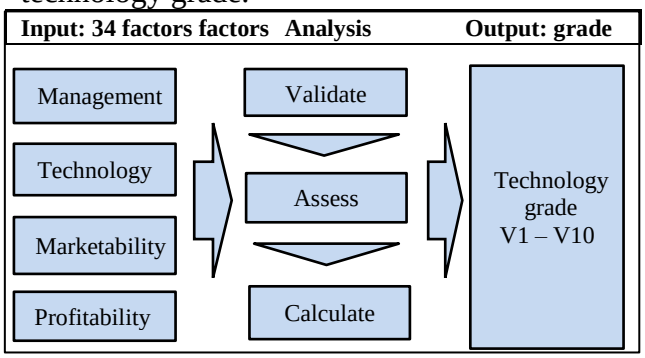

Fig. 6. *Technology grading assessment*

The second part relates to assessing the current financial situation. While the first part evaluates the commercialization and profitbility aspects in future, the first/second? part assesses the financial state the company and the business environment.

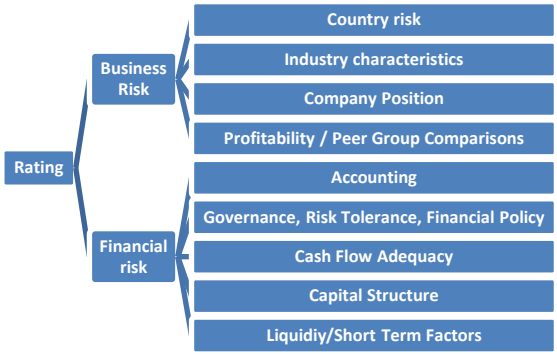

Fig. 7. *Financial risk assessment adopted from [14]*

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Figure 8 illustrates the authors view of the present structure of the ecosystem in Bulgaria. Sofia Tech Park serves as a hub between the academics, entrepreneurs and capital providers. A system that is able to tell apart successful from unsuccessful startps will be of interest of all parties invovled in the ecosystem.

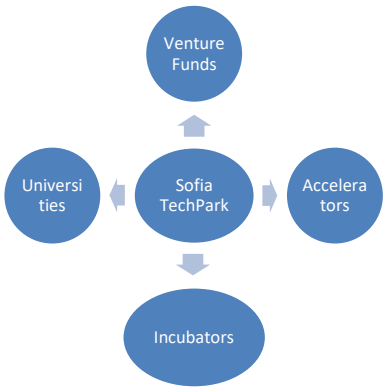

Fig. 8. *Ecosystem in Bulgaria*

A reliable technology appraisal system will improve the allocation of capital.

Among the venture funds that invest in bulgaria are Eleven and LaunchHub. Some of the universities that could benefit from the technology appraisal system are Sofia University, Technical University Sofia, Technical Universityes of Varna, Gabrovo and Ruse and etc.

Universities could focus better its research toward technologies with good prospects of commercialization. Incubators and accelerators will pick companies at seed stage, without any track record and collateral, but having good chances of being noticed by venture funds. The technology appraisal system may also find application in technology transfer, investments, credit and Mergers and Acquisitions (M&A). One interesting use of technology appraisal that has proven itself in Korea is for technology appraisal guarantees [15]. Startups are risky investments and as such they scare off many of the traditional investors. The technology appraisal guarantees provide insurance that a company won't fail in certain period of time. It takes part of the risk and makes the risky technology a more attractive investment.

However, technology start-ups in early stages have mainly intangible assets, which are difficult to valuate. A robust technology appraisal and adoption system would make risky investments in risky ventures and at the same time will increase the return on investment in new technology companies – figure 8. The system can stimulate and support: 1) technological innovation, 2) research and development (R&D, R&BD) processes, 3) foster and encourage all stakeholders in technological innovation and entrepreneurship, and 4) increase public and private sector commercialization.

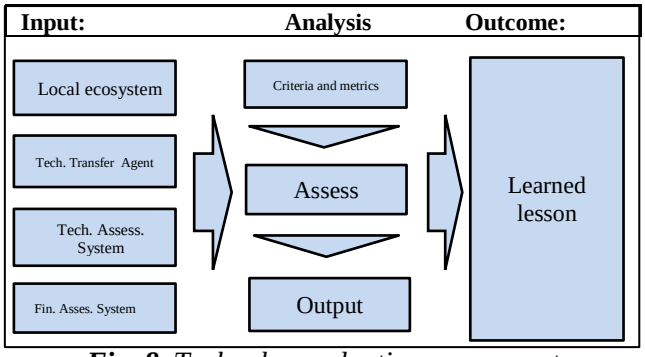

Fig. 8. *Technology adoption assessment*

Covering the analysis is connected with assessment of technology, business and financial assessment, industrial and residential sectors, R&D and R&BD processes. The framework model for technology assessment system connect the ecosystem dots. It could also be used in combination with traditional valuation methodologies, such as income market and cost approaches. These methods are used to calculate the monetary value of the technology. The technology appraisal system will could assess the management, commercialization, technology and profitability aspects and validate the results of the conventional methods.

CONCLUSION AND FUTURE WORK

The low ration of technology adoption at the market is one of the leading factors for failure of start-ups.

A technology appraisal system will have also positive implications on the Bulgarian ecosystem. Increasing the return on investment in risky ventures, will trigger even more investments, which are necessary to foster innovation and entrepreneurship. This will create a virtuous cycle of investments, from which all stakeholders involved in the process will benefit.

Our future plan are to investigate opportunities and to apply for project in many initiatives

from EU and other state and private institutions as the Ministries of Education and Science in Bulgaria and Korea; Knowledge Sharing Program through Ministry of Strategy and Finance between Bulgaria and Korea, etc.

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