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GOVERNMENT'S ANALYSIS, ASSESSMENT AND RESEARCH ACTIVITIES

Perspectives into topical issues in society and ways to support political decision making

Digitalisation, ecosystems, entrepreneurship and policy

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Digitalisation is transforming entrepreneurship in two ways. First, it is shifting the locus of entrepreneurial opportunities in the economy. Second, digitalisation is transforming entrepreneurial practices – or the best ways to pursue those opportunities.

Combined, the two trends have given rise to a novel, distinctively different cluster type, the 'entrepreneurial ecosystem' (Autio, Nambisan, Thomas, & Wright, 2017). Yet, to date, there is little coherent understanding of how digitalisation operates – indeed, what it even means – and what the implications are for entrepreneurship policy. Therefore, the objectives of this policy brief are to:

- Clarify the definition of digitalisation
- Clarify how digitalisation transforms entrepreneurship
- Clarify how digitalisation gives rise to entrepreneurial ecosystems
- Elaborate implications for entrepreneurship and innovation policy

What is digitalisation?

Digitalisation is: "…*the sociotechnical process of applying digitising techniques to broader social and institutional contexts that render digital technologies infrastructural*"[1] (Tilson, Lyytinen, & Sørensen, 2010:749). Put tangibly, digitalisation is the application of digital technologies and infrastructures in business, economy, and society. Digital disruption, then, is the transformative impact produced by digitalisation on how business, economy, and the society operate.

[1] In contrast, digitization is the technical conversion of analogue information into digital form.

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What drives digital disruption?

The current era of digital disruption started in mid-2000s and is underpinned by two important trends: the Moore's Law and the trend towards open architectures and the associated generative properties of digital infrastructures.

Moore's Law remains an enduring regularity. This law states that the amount of computing power that can be acquired for a given amount of money doubles every 18 months. In operation since 1957, Moore's Law has already created several disruptions, such as those involving the application of computers in business enterprises and banking. However, in most of these past disruptions, the computer systems were designed as closed, proprietary architectures that were typically application-, firm- and industry-specific. Therefore, these disruptions seldom had economy-wide ramifications.

The current, economy-wide disruption is underpinned by a shift towards open architectures. The first of these was the Microsoft – Intel (or 'Wintel') alliance from the early 1990s onwards. Although the core elements of the Wintel ecosystem are proprietary (notably, the Windows operating system and Intel chip architectures), the open interfaces made it possible for virtually everyone to contribute applications to the platform. This rise coincided with the emergence of another open architecture, the Internet (Zittrain, 2006). Combined, the two open architectures unleashed the 'Internet revolution' of the 1990s and early 2000s – prompting a wave of entrepreneurial activity at the time. This revolution also disrupted the computer sector, causing it to become modular and for value to 'migrate' from traditional, hardware-centric activities towards software and services.

Open architectures are able to prompt economy-wide disruption because of their generative properties. Generativity is the ability of open architectures to facilitate unprompted, unpredictable innovative inputs from large, uncoordinated audiences. Generativity brings innovation ecosystems to life – indeed, it defines them. For example, the Finnish-Swedish start-up MySQL converted its software into an innovation ecosystem by adopting an open source strategy that enabled many independent developers to contribute improvements to their software (Watson, Boudreau, York, Greiner, & Wynn Jr, 2008). Similar strategies are currently widely used in the Internet to enable users and third parties to contribute generative inputs, e.g., through user reviews, local knowledge, and so on.

The most recent – and arguably, most consequential – wave of digital disruption began to gather momentum in the early half of the 2000s. Significant signposts of this disruption were the coinage of the moniker: 'Web 2.0' in 2004[2], the introduction of iPhone and Android mobile operating systems in 2006-2007, and the subsequent emergence of 'Cloud' computing, web storage, learning algorithms, and 'Big Data' technologies. These advances have enabled ubiquitous access to powerful information processing and storage resources regardless of time and place.

Summarising, the digital disruption is fuelled by a succession of advances in different domains of the digital infrastructure. Importantly, although the effects of this disruption are now felt widely across the society, Moore's Law does not suddenly stop here: the ubiquitously accessible computing power continues to double every eighteen months, ensuring that that this disruption will continue to develop new expressions to be discovered by entrepreneurs.

[2] The moniker: 'Web 2.0' signalled the phase transition of the Internet from a one-way content distribution medium into an interaction platform able to support ever more complex and consequential interactions among multiple stakeholders

Digital affordances and disruptive business model innovation

The power of digital disruption derives from the ability of digital technologies and infrastructures to shape how individuals, businesses, and other economic and societal constituents interact. Digital technologies are, in essence, interaction technologies: they can be harnessed to enhance, extend, and enrich interactions among economic and societal constituents (Autio & Thomas, 2016). These interactions are fundamentally about the exchange of information – digitised into '0's and '1's – for the purpose of value co-creation. This digitisation makes digital technologies and infrastructures generic purpose technologies: they can be applied in any sector, which explains the wide reach of the current era of digital disruption.

The digital disruption operates by creating digital *affordances* – or possibilities to perform existing functions much more effectively than before, or perform entirely new functions (Autio et al., 2017; Majchrzak & Markus, 2013; Zammuto, Griffith, Majchrzak, Dougherty, & Faraj, 2007). Of the affordances created by digitalisation, five are particularly consequential: (1) generativity, as highlighted above, (2) disintermediation, (3) dissociation, (4) ubiquity, and (5) reintermediation (Autio & Thomas, 2016). Generativity is a key affordance that brings both innovation and entrepreneurial ecosystems to life. Disintermediation is the ability of the Internet to support direct interactions between constituents such as service providers and service users regardless of location (Gellman, 1996). Disintermediation makes it possible to cut out the middleman, who can exercise important influence in traditional value chains (Katz, 1988). Dissociation of flows of materials and physical goods from flows of associated information is a key enabler of flexibility in activity system design, and also, a key facilitator of the servitisation of physical and manufacturing activities through concepts such as Mobility as a Service (Caiati et al., 2017). Ubiquity, or the location- and time-independent accessibility of digital technologies and infrastructures, greatly extends the potential applications of these. Finally, reintermediation through various Internet-based platforms (e.g., PayPal, Amazon, AirBnB) is a powerful booster of Internet-based transactions, exchanges, and interactions (Chircu & Kauffman, 2000).

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Because of the nature of digital affordances, the modern 'Digital Economy' is very much an interaction economy, where economic and societal value is 'co-created' in interactions among its constituents. This is different from the 'Manufacturing Economy' paradigm, where value is 'produced' in a linear and vertical manufacturing process. Although manufacturing continues to be relevant, the current digital disruption increasingly emphasises a service-dominant logic of horizontal value co-creation in ecosystem interactions.

Finally, because digital technologies are interaction technologies, they allow radical re-think of how value co-creating interactions are organised in the economy. At the same time, they

also boost the value co-creating ability of those interactions by enhancing (through easier accessiblity and efficiency), extending (beyond the core exchange of goods and services) and enriching them (through greater data intensity) (Autio & Thomas, 2016). This makes digital affordances a potent driver of business model innovation and a key driver of a novel, distinctive type of cluster – i.e., the entrepreneurial ecosystem.

Digitalisation and the transformation of entrepreneurship

Digitalisation both shapes the locus of entrepreneurial opportunities in the economy, and it transforms best practices for the pursuit of such opportunities. These two trends operate in entrepreneurial ecosystems – or communities of stakeholders and specialised resources that support the creation and scale-up of new business ventures.

Entrepreneurial ecosystems differ from traditional types of regional agglomerations (e.g., clusters, industrial districts, regional systems of innovation) in three respects: (1) the organisation of their specialised resources (around the start-up and scale-up of new ventures); (2) dominant networking and competition patterns (horizontal networking, vertical competition); and (3) dominant forms of knowledge spill-over (specialising on entrepreneurial opportunity pursuit and scale-up through radical business model innovation (Autio et al., 2017).

Spatial proximity facilitates four types of externalities that benefit business in regional agglomerations: (1) specialisation; (2) resource access; (3) reduced transaction costs; and (4) knowledge spill-overs. The first three operate similarly in entrepreneurial ecosystems as in traditional regional agglomerations. However, knowledge spill-overs, are distinctively different in entrepreneurial ecosystems. Traditional agglomerations share a knowledge base that is technical in nature – either specialised in a given industry sector (e.g., a furniture cluster) or technology (e.g., a biotechnology cluster). In entrepreneurial ecosystems, the shared knowledge base concerns a generic business process – i.e., how to organise effectively for entrepreneurial opportunity pursuit and scale-up through radical business model innovation.

Firms gravitate towards traditional agglomerations because they can learn more effectively about a given industry or technology. Start-ups gravitate towards entrepreneurial ecosystems because they can become more effective in organising for scale-up and in discovering radical business models that can challenge established industry incumbents.

These differences prompt a distinctive pattern of networking and competition in entrepreneurial ecosystems. Traditional agglomerations typically consist of linear and vertical value chains that point to specific markets. This means that firms in the same stage of the value chain are potential substitutes who compete with one another. In contrast, firms in successive stages of the value chain (e.g., a component supplier and sub-assembly manufacturer) are complements and do not compete. This gives rise to a pattern of horizontal competition (among firms in the same value chain stage in the cluster) and vertical networking (among firms in successive stages of the value chain in order to optimise their transactions).

In contrast, entrepreneurial ecosystems are characterised by horizontal networking (in the same ‘value chain stage’) and vertical competition (against traditional industry incumbents that are located outside the cluster). This is because each new venture points to its own market with a distinctive offering. Therefore, horizontally related ventures in entrepreneurial ecosystems are not potential substitutes and thus do not compete with one another. Yet, they all compete with the same means –radical new business models that challenge traditional leaders of established industry sectors. Therefore, the new ventures have a natural incentive to share their experiences from business model experiments, because such sharing enables all new ventures in the ecosystem to become more effective in challenging industry incum-

bents. This pattern explains the distinctive culture of entrepreneurial ecosystems, one that emphasises knowledge sharing and peer mentoring and celebrates success.

Reinvention of established SME business models through new venture creation

Above, I have explained the characteristic features of digital disruption and how it drives innovation and entrepreneurial ecosystems and shapes the locus of entrepreneurial opportunities and effective entrepreneurial practices. It is important to note, however, that the effect of digitalisation will not be limited to a specific sub-group of new ventures – i.e., 'e-business' or 'digital start-ups'. While many new ventures operate purely digitally, digital technologies can be used to extend, enhance, and enrich boundary-spanning interactions in virtually any new venture or small- and medium-sized enterprise. As an example, a recent survey found that 76% of Swiss SMEs from different sectors expected digitalisation to transform their markets in the next five years (Greif, Kühnis, & Warnking, 2016). It is therefore important not to limit the consideration of digitalisation and entrepreneurial ecosystems to 'digital start-ups' alone, but consider the effects of digitalisation on all SMEs and small businesses. With specific reference to more traditional SMEs, two policy priorities therefore arise: (1) facilitating the reinvention of established SME business models through de novo start-up activity; and (2) facilitating the digital transformation of existing SMEs. I next address each in turn.

Responding to the broad opportunity space opened by digitalisation, entrepreneurial ecosystems have emerged as a novel cluster type that facilitates the cultivation and dissemination of generic business process knowledge (i.e., the pursuit of entrepreneurial opportunity through radical business model innovation) and provides a community that offers rich and munificent resources for entrepreneurial scale-up. These communities support three distinct stages of the new entrepreneurial dynamic: (1) the stand-up stage (i.e., the self-selection of individuals to entrepreneurship); (2) the start-up stage (covering the experimentation stage in search for robust and scalable business models); and (3) the scale-up stage that begins when a robust and scalable business model has been discovered (Autio et al., 2017).

The challenges of entrepreneurial ecosystems for entrepreneurship policy have been discussed by Autio and Levie (2017), Autio and Rannikko (2017), and Autio (2016). The most important implications arise from the focus on facilitating a system-level entrepreneurial dynamic (i.e., the stand-up, start-up, and scale-up processes); identification and correction of 'ecosystem failures'; facilitation of business model experimentation (and associated spillover); facilitation of platform momentum; and proactive regulation (i.e., 'regulatory sandboxes').

Policy actions should consider the three sub-dynamics of the digital economy entrepreneurial dynamic: stand-up, start-up and scale-up dynamics

First, policy should consider the three sub-dynamics of the digital economy entrepreneurial dynamic. Entrepreneurship policies should detect bottlenecks that constrain each dynamic and structure interventions accordingly. For the stand-up stage, policies should support the

self-selection of well-qualified individuals to the entrepreneurial experimentation process. In practice, this would call for a significant expansion of the teaching of entrepreneurial experimentation (i.e., an adaptation of the lean entrepreneurship discipline) in Finnish educational institutions – and also, facilitating international inflows (and outflows) of entrepreneurial talent. For the start-up stage, policies should ensure that the required structural elements are in place to cultivate cluster-level knowledge on effective organisation for entrepreneurial opportunity pursuit (e.g., accelerators, co-working spaces). For the scale-up stage, policies should ensure the presence of scale-up competence and associated resources within the Finnish entrepreneurial ecosystem.

Second, policy should focus on fixing 'ecosystem failures'. These are failures of the ecosystem to generate desired outcomes (e.g., innovative and high-growth new ventures). Traditional entrepreneurship policies seek to fix either 'market failures' (e.g., firms do not invest in R&D due to fears of misappropriation) or 'structural failures' (e.g., structural gaps in regional systems of innovation). Both of these are static in nature, observable from the outside, and amenable to being fixed through top-down policy action (e.g., R&D subsidies, building science parks). Entrepreneurial ecosystem failures are different: they are dynamic and produced in interactions among ecosystem constituents (Autio & Levie, 2017). Thus, they are less easy to observe from the outside and less amenable to top-down intervention. Therefore, entrepreneurial ecosystem policies should seek to engage ecosystem stakeholders into a shared sensemaking process to discover ways how to improve the functioning of such systems. Ecosystem policy interventions should adopt a facilitative engagement approach and assist in improving the interaction dynamic within the ecosystem.

Third, policies should facilitate business model experimentation and the spill-over of experiences thereof. In practice, this could mean, e.g., focus on improving the functioning of accelerators, co-working spaces, and makerspaces. An important role of the policy-maker is also likely to be the initiation of sizeable enough demand injections in specific sectors of the Finnish economy to support business model experimentation and associated knowledge spill-over (Autio & Rannikko, 2017). This could happen, for example, by opening public procurement in, e.g., selected areas of the health care sector for business model experimentation by new ventures (e.g., the generation of two-sided market platforms for healthcare services).

Fourth, policies should enable the generation of momentum around new platforms (e.g., in IoT sectors). This could take place in the form of public-sector demand injections in selected target sectors (see point three above) or through large-scale infrastructural investments. As an example, Singapore is currently investing significantly in the development of IoT platforms, involving important developments around Singapore's ports.

Finally, small advanced economies like Finland can gain an advantage in platform creation through concerted policy action. Industry and ecosystem platforms constitute one important 'product' of entrepreneurial ecosystems, and this product does not need to be the exclusive preserve of large economies. Small advanced economies can harness their agility in ecosystem engagement and cross-silo policy coordination to create 'regulatory sandboxes' to support proactive regulatory experimentation in domains that might support the creation of new industry platforms. As mentioned above, Singapore is investing in cultivating IoT-centric platforms in spite of its small manufacturing base. Finland could experiment proactive, business model innovation –facilitating regulation in selected areas where platforms are yet to emerge – e.g., in Mobility as a Service contexts, in city system contexts, in healthcare, and similar. As radical new business models often introduce concepts that the regulators have been unable to anticipate (e.g., Uber and AirBnB), proactive regulation combined with public-sector demand pull could help create crucial early-stage momentum for innovative platforms to enable

these to establish themselves as international standards by exploiting direct and indirect platform externalities.

Transformation of business models of established SMEs through digitalisation

The second set of policy challenges relates to the digital transformation of existing SMEs in the economy. Above I quoted data from Switzerland, where 76% of existing SMEs expected their markets to be transformed through digitalisation. This is a major disruption that creates the need for targeted policy action to address established SMEs. Although the majority of SMEs expect their markets to be disrupted, they currently lack the tools to proactively re-think their business models so as to leverage the potential of digitalisation.

Digitalisation creates opportunities for existing SMEs to proactively re-think both their internal and external interactions and how they co-create, deliver, and capture value in their interactions with customers, partners, suppliers, and internal stakeholders.

In framing policy needs in this area, I suggest conceptualising of SME business models as boundary-spanning interaction systems, where the application of digital technologies supports the enhancement, extension, enrichment, and reconfiguration of value-creating interactions internally and externally, with internal stakeholders, customers, partners, and suppliers. Viewed through the interaction system lens, digitalisation creates opportunities for existing SMEs to proactively re-think both their internal and external interactions and how they co-create, deliver, and capture value in their interactions with customers, partners, suppliers, and internal stakeholders. A summary of actions that could be supported through policy interventions is shown in Table 1.

Table 1 Policy actions to support the digitalisation of existing SMEs' business models

Interaction category	Digitalisation opportunities
SME's internal activity system	Overall objective: Increasing the efficiency and scalability of the SME's internal administrative and activity system through the application of digital technologies and through outsourcing administrative services and productive activities Example: digitalising and outsourcing administrative services such as accounting, personnel management, salaries Example: outsourcing manufacturing services to external providers – e.g., through Alibaba
Customer interactions	Overall objective: Extending and enriching customer engagements through the application of digital technologies, there by increasing customer utility, satisfaction, and retention Example: Digitalising customer interactions and regularised communications (e.g., contact forms) over company website Example: Extending visibility and participation in social media (twitter, Facebook, others) Example: Offering internet-based reservation systems Example: Offering dedicated applications that enable access to SMEs products and services Example: Promoting user communities and digital interactions among users Example: Operating digital FAQs and other community resources
Digitalisation of products and services	Overall objective: Enriching, enhancing, and extending value offered for users by extending existing products with digital features Example: Servitising physical goods by adding connectivity to internet Example: Servitising physical goods by offering access to them as a service Example: Extending users' ability to access, engage with, and customise the product or service experience through digital applications Example: Enhancing connectivity among customers through digitally-enabled user communities Example: Enabling customers to more closely engage with new developments (including new product development) through digital interaction devices Example: Collecting and harnessing customer data for the development of new products and services and extending existing ones (e.g., recommendation services) Example: Platformisation of SME products and services
Digitalisation of marketing	Overall objective: Enhancing the SME's reputation by exploiting digital channels and developing online reputations Example: Enhancing the SME website to drive brand strength Example: Use of targeted online marketing campaigns to reach new customer groups Example: Developing an online presence in social media channels Example: Developing digital marketing materials for viral distribution in social channels
Internationalisation	Overall objective: Leveraging digital platforms for initiating and enhancing the SME's cross-border interactions and sales Example: Connecting to Internet reintermediaries for product sales (e.g., Amazon, Alibaba) Example: Harnessing Internet reintermediaries and trust technologies for online reputation and enhanced customer trust (e.g., transactions and deliveries guaranteed by Internet platforms such as PayPal) Example: Leveraging blockchain technologies for supply chain transparency and proof-of-origin Example: Connecting to cross-border digital supply chains

Finland's entrepreneurial ecosystem does not seem to be very efficient in cultivating challengers to established incumbents – a key role of entrepreneurs in the digital economy.

Reflection of Finland's entrepreneurial dynamic through the GEI data

Finally, I consider specific strengths and weaknesses of the Finnish entrepreneurial ecosystem. The latest GEI data is shown in Figure 1 and Table 2, showing Finland's profile against Sweden, the Netherlands, and the United Kingdom. There is a clear pattern: Finland shows strengths in entrepreneurial attitudes (pillars 1-5) but weaknesses in entrepreneurial abilities (pillars 6-9) and entrepreneurial aspirations (pillars 10-14). The biggest gaps are in Competition Effects and Human Capital flowing into new ventures (pillars 9 and 8). Competition Effects measure the number of existing competitors of new ventures, weighted by competition regulation. This pillar suggests that Finland's entrepreneurial ecosystem experiences a deficiency in its ability to introduce competitive novelty through the entrepreneurial dynamic. In other words, at present, Finland's entrepreneurial ecosystem does not seem to be very efficient in cultivating challengers to established incumbents – a key role of entrepreneurs in the

digital economy. Similarly, the quality of the Human Capital flowing into new ventures tends to lag behind that of selected peer economies, suggesting qualitative inefficiencies in the stand-up system. In addition, Finland's scale-up system appears in general need of strengthening.

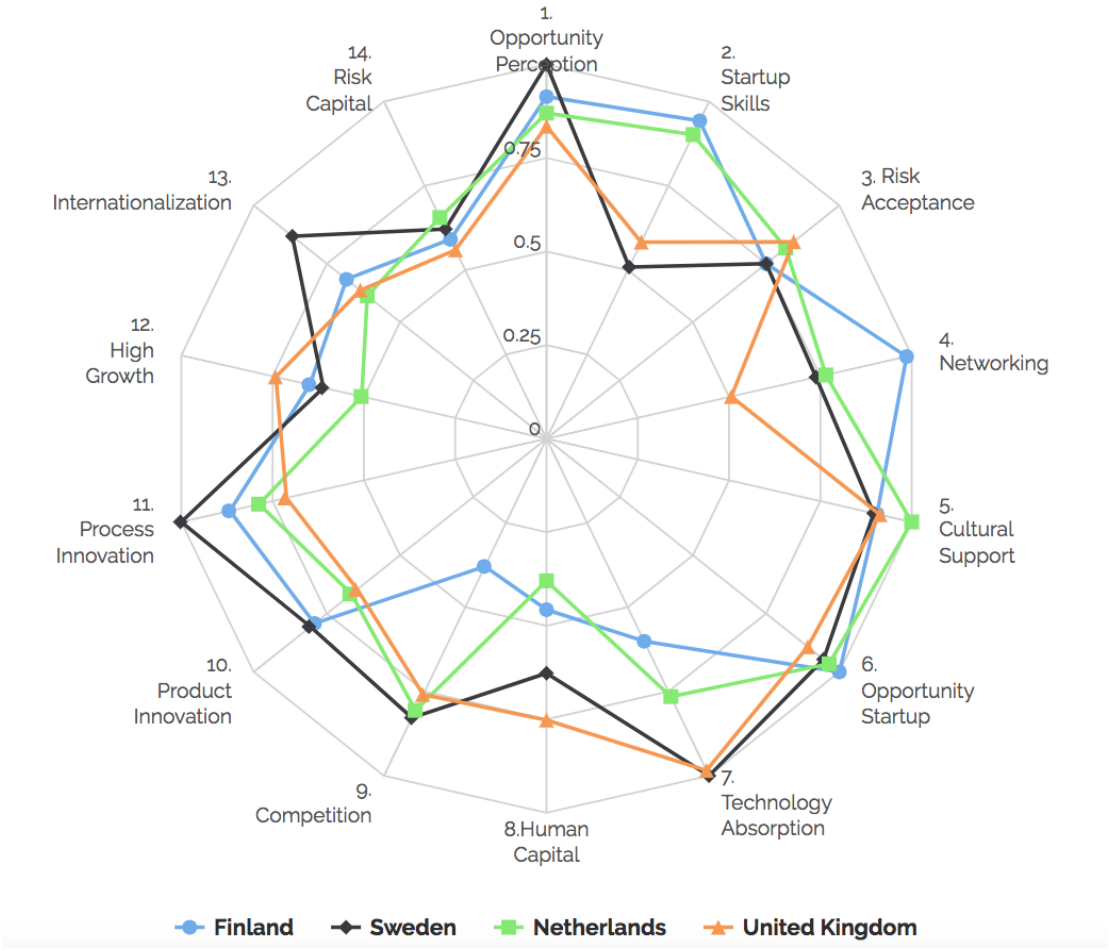

Figure 1. Finland's entrepreneurial ecosystem profile against selected peers (source: GEDI)

Table 2 shows that many of the weaknesses in Finland's entrepreneurial ecosystem dynamic appear traceable back to individual-level variables, as operationalised by GEDI. Notable gaps (relative to peers) can be observed in Skill Perception and Career Status, again suggesting specific deficiencies in the stand-up system. Competitive novelty and Educational Level of entrepreneurs were already noted. There also appears to be a relative weakness in the creation of new ventures introducing new technologies (in the linear technology translation mode) in the economy.

Table 2. Finland's entrepreneurial ecosystem: Detailed profile

	PILLARS		INSTITUTIONAL VARIABLES		INDIVIDUAL VARIABLES	
Entrepreneurial Attitudes	Opportunity Perception	0.91	Market Agglomeration	0.98	Opportunity Recognition	0.69
	Start-up Skills	0.94	Tertiary Education	1.00	Skill Perception	0.42
	Risk Acceptance	0.75	Business Risk	1.00	Risk Perception	0.52
	Networking	0.99	Internet Usage	0.94	Know Entrepreneurs	0.69
	Cultural Support	0.90	Corruption	1.00	Career Status	0.46
	Entrepreneurial Attitudes	78.27				
Entrepreneurial Abilities	Opportunity Startup	1.00	Economic Freedom	1.00	Opportunity Motivation	0.83
	Technology Absorption	0.60	Tech Absorption	0.87	Technology Level	0.71
	Human Capital	0.46	Staff Training	0.64	Educational Level	0.58
	Competition	0.38	Market Dominance	0.68	Competitors	0.36
	Entrepreneurial Abilities	56.31				
Entrepreneurial Aspirations	Product Innovation	0.79	Technology Transfer	1.00	New Product	0.61
	Process Innovation	0.87	GERD	1.00	New Tech	0.42
	High Growth	0.65	Business Strategy	0.95	Gazelle	0.58
	Internationalisation	0.68	Globalization	0.95	Export	0.71
	Risk Capital		Depth of Capital Market	0.81	Informal Investment	0.69
	Entrepreneurial Aspirations	66.16				
	GEI	66.91	Institutional	0.92	Individual	0.59

Overall, this analysis suggests that although Finland's stand-up system appears strong on the surface, there appear to be specific gaps that may require a re-think of how entrepreneurial experimentation is taught as a life skill in Finnish educational institutions, and how wide the reach of such education should be. As one suggestion, perhaps a hands-on, experiential approach could help, one model of such initiatives being offered by Singapore's Overseas Campuses programme, which sends university student to one-term or one-year study internships to selected entrepreneurial hotspots (e.g., Silicon Valley, Boston, Shanghai) for a 6- to 12-month immersion in an entrepreneurial venture, complemented by related studies. This programme has been found to be highly effective in encouraging entrepreneurial attitudes among university graduates.

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