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Barriers to digitalisation in Finnish SMEs

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ABSTRACT

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The purpose of this work is to look for the barriers to digitalization in SMEs. The work is carried out as a literature survey. The situation in Finland is also discussed separately. SMEs play an important role in the development of industry 4.0 smart production chains and product lifecycle management. SMEs face a wide range of challenges in developing digitalization. Due to their smaller size, their resources are lower, and it is more difficult to hire experts. SMEs often do not have the direct contact to end customers but act as suppliers. That makes them more difficult to get real-time information enough to their development work. Their financial resources are lower than those of larger companies. Venture capitalists favor start-ups, and especially in Finland does not have a culture of financing later-stage production companies. Because most technical solutions are designed to meet the needs of large companies, in SMEs this means demanding deployment. To take full advantage of Industry 4.0, it would be important for larger companies to take better account of the situation of SMEs when developing their own business. This is because it is indeed the only opportunity to develop complete production chains, manage the life cycle of the product and take environmental issues fully into account. It is important to train specialists, but even more important to educate the senior management and boards of SMEs. When decision-makers see the potential of digitalization in their own business, digitalization will become an integral part of business.

Keywords: Small and medium-sized enterprises, digitalization, barrier, industry

TIIVISTELMÄ

Digitalisaation esteet suomalaisissa PK- yrityksissä

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Tämän työn tarkoituksena on etsiä digitalisaation esteitä pk-yrityksissä. Työ toteutetaan kirjallisuusselvityksenä. Suomen tilanne käsitellään erikseen. Pk-yrityksillä on tärkeä rooli teollisuus 4.0 älykkäiden tuotantoketjujen ja tuotteiden elinkaarihallinnan kehittämisessä. Pk-yritykset kohtaavat monenlaisia haasteita digitalisaation kehittämisessä. Pienen kokonsa vuoksi niiden resurssit ovat pienemmät ja asiantuntijoiden palkkaaminen on vaikeampaa. Pk-yrityksillä ei useinkaan ole suoraa yhteyttä loppuasiakkaisiin, vaan ne toimivat tavarantoimittajina. Tämä tekee heille vaikeammaksi saada tarpeeksi reaaliaikaista tietoa kehitystyöhönsä. Niiden taloudelliset resurssit ovat pienemmät kuin suurempien yritysten. Pääomasijoittajat suosivat startup-yrityksiä, eikä varsinkaan Suomessa ole kulttuuria myöhemmän vaiheen tuotannollisten yritysten rahoittamiseen. Koska suurin osa teknisistä ratkaisuista on suunniteltu vastaamaan suurten yritysten tarpeita, tämä tarkoittaa pk-yrityksissä vaativaa ja kallista käyttöönottoa. Teollisuus 4.0:n täysimääräisen hyödyn saamiseksi suurempien yritysten olisi tärkeää ottaa paremmin huomioon PK- yritysten tilanne kehittäessään omaa liiketoimintaansa. Tämä johtuu siitä, että se on ainoa mahdollisuus kehittää kokonaisia tuotantoketjuja, hallita tuotteen elinkaarta ja ottaa ympäristöasiat täysin huomioon. On tärkeää kouluttaa asiantuntijoita, mutta vielä tärkeämpää on kouluttaa PK- yritysten ylintä johtoa ja hallituksia. Kun päättäjät näkevät digitalisaation mahdollisuudet omassa liiketoiminnassaan, digitalisaatiosta tulee kiinteä osa liiketoimintaa.

Asiasanat: digitalisaatio, pienet ja keskisuuret yritykset, teollisuus, esteet

PREFACE

I have worked for more than 20 years in Finnish industrial companies both as an employee and an entrepreneur. I set up my first business in 1996 on a paper form I ordered by landline, the form came in the mail in due course. In the late 1990s, the importance of computers grew, and everyday communication became electronic and information management was increasingly handled electronically. The sound of fax, modem and dot matrix printer is sure to be remembered forever. Automatic machine tools were used in production, but most of the time the information was only available on machines, the utilization of internal networks was still limited. Programmable logics had been in use in the industry for a long time and there did not seem to be a substitute for them. ERP systems were simple and robust and only operated on intranets, except for one-way and very expensive EDI connections for large companies. I bought my first cell phone in 1994. At the time, it was used, incredibly, mainly for talking.

In just over twenty years, technology has experienced a huge leap forward. The Finnish infrastructure enables fast and uninterrupted telecommunications connections. Advances in technology have made it possible to develop automation and process ever-increasing data flows. Finnish education is of the highest level and experts graduate from educational institutions. We talk about industry 4.0. Industry 4.0 is the fourth industrial revolution involving robotics, the Internet of Things (IoT), the Industrial Internet of Things (IIoT), cloud computing, and machine learning, among others. The term industry 5.0 adds human-machine interaction to the equation.

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1 INTRODUCTION

In Finland, small and medium-sized enterprises (SMEs) are defined as enterprises with less than 250 employees and an annual turnover not exceeding EUR 50 million (EUR 40 million before 2003) or a balance sheet total not exceeding EUR 43 million (EUR 27 million before 2003) and meet the criterion of independence. Independent companies are companies in which 25% or more of the capital or voting shares are not owned by one company or jointly owned by companies that do not fall under the definition of either an SME or a small company. (Tilastokeskus, 2021).

Three bottlenecks have been identified for Finland's growth: underemployment, poor productivity growth and a lack of productive investment. (Stenborg et al. 2021). These are three directly related challenges that digitalization can provide a means to address. The shortcomings of the previous otherwise deserving report are reflected in the way we think that robotics reduces jobs. This argument has been further refuted in several reports both in Finland and US. (IFR Press 2021)- report tells us clearly, that robots enable competitive advantages that makes possible to grow the business and the number of the employees. Without digitalization the competition may be impossible in the international market. Without robotics, it is impossible to be involved in industry operating in the international market. Robotics does not reduce jobs but enables new jobs for industry in Finland. Increasing automation is the only way to be involved in industrial activities in the global market. (Latokartano 2021.)

In my experience, the state of digitalization varies a lot in Finnish SMEs. Companies may lack the level of technical maturity required by Industry 4.0. The demand for centralized data management and its security may be out of reach for many SMEs. It should also be remembered that Industry 4.0 is by no means just about in-house development. It is not enough to develop an individual factory, but supply chains must develop together. Therefore, it is so important to develop the digitalization of SMEs.

1.1 Objectives of the work

Although the progress of digitalization in Finland is considered important, many SMEs still face challenges. SMEs have several characteristics that make it hard for them to develop in digitalization. Their limited resources and skills are often considered the major barrier in progress (Kumar et al. 2020). However, it is important to look for other limiting factors too. Smaller size and less resources are key features of an SME and are therefore difficult to influence.

The aim of this work is to find out, through literature research, what obstacles and slowdowns SMEs experience in the development of digitalization in Finland. The issue will first be addressed more widely through the international literature. Finally, the focus is on the Finnish operating environment, keeping in mind the challenges of digitalization in the international environment, considering whether an internationally emerging factor could also exist in Finnish industry, but research data on it do not yet exist.

2 LITERATURE REVIEW

2.1 Concept of industry 4.0

At the Hanover Fair in 2011, the German government announced the concept of “Industrie 4.0” as part of its high-tech strategy. The concept, later known as Industry 4.0, was originally aimed for securing the future competitiveness of the German manufacturing industry. As a whole, it is called the fourth Industrial Revolution, based on cyberphysical systems (CPS) and the Internet of Things (IoT). (Müller & Kazantsev 2021). CPS aims to resemble and extend the physical world in entire value chain. Industry 4.0 enables horizontal and vertical integration, across entire industrial value chains, across the entire lifecycle of products, and across several functional departments (Dalenogare et al. 2018; Kagermann et al. 2013; Lasi et al. 2014).

2.2 Roles of SME

This aims to regard SMEs as part of entire supply chains that span the globe, that is, as part of industrial ecosystems. Many SMEs, in fact, have an important role in executing different kind of services. In this regard, SMEs despite their small size, need to be integrated into supply chains and ecosystems to achieve horizontal and vertical integration as a central pillar of Industry 4.0 (Benitez et al. 2021; Hahn 2020; Schmidt et al. 2020). To exploit the full potential of Industry 4.0, holistic systems across entire value chains and lifecycles of products are necessary that enables smooth representations between these two worlds. The establishment of such holistic systems is a key requirement to extend the linear economy to a Circular Economy (Rizos et al. 2016; Zamfir et al. 2017) that replaces the “end-of life” concept with reducing, alternatively reusing, recycling, and recovering materials in production / distribution and consumption processes (Kirchherr et al. 2017). Hence, also for large enterprises and entire supply chains, the implementation of Industry 4.0 in SMEs is vital. (Birkel & Müller 2021; Veile et al. 2020.) Based on the expected benefits of the fourth Industrial Revolution, many approaches have been developed that relate, so far, mostly to the application in individual factories, but not across entire value chains (Bag et al. 2020; de Sousa Jabbour et al.

2018). However, the understanding of Industry 4.0 across entire supply chains, functional departments, or the entire lifecycle of products is required to approach the benefits of a circular economy but is significantly less developed than within single factories or firms. SMEs play a key role in the successful implementation of Industry 4.0 and the circular economy, as they have specific expertise and often niche-specific know-how that is of high importance for supply chains. (Birkel & Müller 2021) An industrial revolution is characterized by fundamental changes for industrial value creation, but also for society and environment.

Cyber-physical systems and the Internet of Things represent the technological foundation for Industry 4.0, which allows three forms of integration through digital technologies: Horizontal interconnection across the supply chain, vertical interconnection across functional departments, and end- to- end engineering, from product development to recycling, i.e., along the entire lifecycle of products (Kagermann et al. 2013). Raw materials processing activities and component manufacturing, as well as recycling activities, are often conducted by SMEs (Müller & Voigt 2018).

2.3 Barriers of digitalization in industry

SMEs have several characteristics that make it harder for them to approach the potentials of Industry 4.0. They have limited resources and skills, and they are often acting as suppliers without direct end-customer contact. SMEs face size-specific challenges, as lower levels of digitization compared to larger enterprises (Kumar et al. 2020; Müller et al. 2020; Virmani et al. 2020). While major companies are advancing in digitalization, the knowledge is not always disseminated throughout their supply networks (Mittal et al. 2020). SMEs have low bargaining power compared to larger enterprises. Further, feared transparency of SMEs towards competitors, customers or third parties impedes the implementation of Industry 4.0 within entire supply chains (Kumar et al. 2020; Müller & Voigt 2018; Virmani et al. 2020). However, to achieve end-to-end engineering, horizontal and vertical interconnection of the integration of SMEs is essential since they encompass 99.5 percent of all European companies and generate share data with their customers. Further, SMEs do not receive data they require for optimizing their own product

development, production, or recycling activities. This is because many SMEs often do not have direct contact to end customers but act as suppliers. (Bag et al. 2020; de Sousa Jabbour et al. 2018; Kumar et al. 2020; Rahman et al. 2020; Mittal et al. 2018; Moeuf et al. 2018; Schmidt et al. 2020; Veile et al. 2020; Virmani et al. 2020).

It becomes clear that manufacturing companies, and mainly SMEs, need to become aware of the industry 4.0 paradigms and understand how its emerging technologies may contribute to the company's business evolution. Therefore, companies' leaders and managers need to understand which technologies are needed and how they can be combined to leverage the company value proposition. On the other hand, workers and students need to learn how to use these technologies. (Azevedo et al. (2021). Sharing methodological toolkits in the ecosystems would thereby create enormous opportunities for start-ups and SMEs in terms of providing a baseline for strategic and market orientations, exemplifying business operations (Sahi et al. 2020).

2.4 Industry sector in Finland

Finland is an economically and socially stable Nordic country of 5.5 million inhabitants. The infrastructure and logistics are top notch (Kaivo-Oja et al. 2018). In Industry 4.0, Finland ranks near the top too (Khan et al.2021). The Finnish industry is based on high-value- added export-oriented manufacturing (Ciffolilli & Muscio 2018) because of its small domestic market. Finnish manufacturers need to be flexible, trusty, and able to provide the latest technology solutions (Kaivo-Oja et al. 2018). Nearly 86 percent of Finnish exports were industrial goods in 2005, but in 2019 the share of services has risen to 33 percent (Confederation of Finnish Industries 2020) with 17 percent annual growth (Statistics Finland 2021) while growth on goods exported was only 2 percent. The focus on end products is clear; more than 80 percent of intermediate goods and components were coming from abroad (Ali-Yrkkö & Kuusi 2020).

2.5. Digitalization in Finland

The concept of Industry 4.0 aims to gather, transmit, and analyse data throughout these three forms of integration, enabling several benefits. (Khan et al. 2021). Shift towards digitalization could be seen to have started in the mid-1990s, when the value added in the electronics and electrical products sector exceeded both the wood and paper and machinery and equipment sectors. In recent years, between 2015 and 2020, the GDP has steadily grown (Statistics Finland), and there is also evidence of manufacturing jobs being reshored to Finland lately (Kaivo-Oja et al. 2018). Key developments in the national Industry 4.0 strategy in Finland beginning from the year 2011 are: (2011-2015) Vision and strategy creation, (2015-2017) Technology and solution development, (2017-2020) Ecosystems and AI- driven value and (2021-) Sustainable Industry 4.0 ecosystems. (Khan et al. 2021).

2.6 Barriers to digitalization Finnish SMEs

The Finnish industry is characterized by customized offerings, which makes it hard to find off-the-shelf/ single-source solutions. To be able to find total solutions, larger companies need to collaborate with the SMEs to provide expanded solutions. (Khan et al. 2021). Finland lacks the culture and resources for later-stage venture capital investments compared to many other countries (Saarikoski et al. 2014), which hinders its SMEs' growth in international markets. While the start-up culture itself is quite strong, there is only few start-ups oriented towards manufacturing industry innovation. (Khan et al. 2021). In addition to venture capital, SMEs, particularly microenterprises, are underrepresented in government support for companies. For instance, micro and small enterprises only represent 6.2 percent and 22 percent, respectively, of subsidy receivers. Additionally, regarding Industry 4.0, digitalization money is not effectively targeted towards manufacturing. (Statistics Finland 2020)

However, even if the technology development sounds tempting, it is often hard to estimate the business benefits it can provide. SMEs do not have enough resources to identify, evaluate, test, and pilot all digitalization solutions to gain their full benefits. The

profitable digitalization solutions identified by the forerunner companies would have to be scaled down to typically low-volume SME production (Khan et al. 2021). Finland has experienced a natural decrease in population growth leading to a lack of young people for future technological development (Santos et al. 2017), creating a gap between the skills of traditional factory workers and the new skills needed on the job. This is significant, as a Deloitte study has predicted that technology will likely create more jobs in the manufacturing industry (Wellener et al. 2020), posing a challenge for procuring skilled and motivated labour for the industry in Finland. Thus, as production costs are high in Finland and most likely will stay that way, the level of automation and optimization of production processes must be under constant development to keep the competitive edge. Companies joining in implementing Industry 4.0 lack best-practice examples from successful organizations. However, a successful 4.0 implementation depends on the integration of SMEs, because of their high relevance within supply chains. (Khan et al. 2021)

Areas of improvement and barriers to implementation have been recognized. Finland's population is one of the oldest in Europe and is rapidly aging (Finnish Institute for Health and Welfare 2020), causing serious concerns for recruiting a workforce with an up-to-date set of skills. Improving digital skills in SMEs is also a key objective in the national AI 4.0 program launched in late 2020 (MEE 2020). The focus on high-value-adding markets indicates that implementing off-the-shelf solutions is often impossible, resulting in higher costs and lead times in the implementation of digital solutions leading to higher costs of implementation, especially in SMEs.

The investigation of the industrial SMEs of Sievi, Ylivieska, and nearby areas points out, that the companies are facing quite similar challenges and needs with each other, and they are usually related to the inefficiency of cross-organizational collaborations, the utilization of modern technologies, or the availability of talented workforce or financial resources. Companies are interested in increasing their own technology levels and investing in new production tools and devices, but due to the shortage of money, those actions are typically very challenging to execute. What makes the situation even more challenging is, that even though there were suitable people available for the companies, they do not always have enough resources to employ them. (Severinkangas 2021).

3 DISCUSSION

In Finland, there is a particular shortage of investments by later-stage private equity investors. This hampers the growth of SMEs in international markets. The start-up culture is strong, but it is not usually about innovation in the manufacturing industry. The share of public funding for micro and small enterprises is low and even then, it is not usually directed at productive enterprises (Statistics Finland 2020). Change in the allocation of funding would be important. Information systems are often designed for large companies. Developing them for small businesses is important for better cost-effectiveness and usability. Developing best practices as a model could also help companies move forward in development.

The study in Northern Ostrobothnia found shortcomings in the co-operation between companies / companies and other actors. (Severinkangas 2021). It is challenging for a small business to participate in multi-player development projects due to resource and schedule issues. Development work is always out of the working hours, so there are simply not enough resources for development during busy times. The skills of the current staff were not necessarily sufficient to introduce the new technology. Although not directly asked, research shows that the development of digitalization is not necessarily the strongest area for the entrepreneur himself, so recruiting experts is a key issue in development. Experts may not be found in the area and the distances are long if a potential expert is found. The worst option was considered to be insufficient financial resources in SMEs, even if suitable experts were available (Severinkangas 2021).

In my experience, the most effective developer is a demanding customer. When digitalization is developed in relation to the customer's requirements, the focus is clear, and the company understands the necessary solution. In that case, it is sufficient that the technical implementation and maintenance can also be purchased from another company. If it is difficult for a small business to hire an employee, a purchasing service could be a good solution. If the development work does not employ an expert full time, he is an expensive worker. In addition, it may be difficult to keep him in the company for long periods of time. This, of course, also requires the purchaser of the service to have

sufficient information about the possibilities of the methods. Other studies also see limited resources and skills as the main obstacle to the development of digitalization. (Bag et al. 2020; de Sousa Jabbour et al. 2018; Kumar et al. 2020; Rahman et al. 2020; Mittal et al. 2018; Moeuf et al. 2018; Schmidt et al. 2020; Veile et al. 2020; Virmani et al. 2020). In addition, it is typical for SMEs to supply part of a product or service and thus not be in direct contact with the end customer. Thus, they also do not receive information directly from the end customer to develop their own processes, but rely on information provided by their own customer, such as order schedules. As a small player is the most easily replaced, transparency in the supply chain is also perceived as a threat to a small company. Continuous price competition and the uncertainty of lasting customer relationships make it impossible to develop digitalization through production chains.

The most interesting study was a study in Portugal on managing the opportunities for the digitalization of business management. (Azevedo et al.2021). It is essential that company management understands digitalization and the opportunities it offers for business development. The need for learning and maturity tests were identified and a learning platform was developed to develop competence. Business management does not need to know how to adopt technology, but they need to understand enough that they see the opportunities it offers in their own business and are able to guide their own staff or select suitable partners.

My argument is that maybe the basic problem is with the skills of corporate management. When there is uncertainty about the subject, the necessary decisions are not made. If images of the difficult adoption, uncertain operations, and high cost of information technology of those past decades are in good memory, everything new is scary and avoidable where possible. I have been told that it does not matter in Finland, because no “bulk goods” are produced here. Well, it’s certainly not produced because it’s no longer “handmade” in China and elsewhere in the Far East either. Indeed, the world's largest concentration of robots is in South Korea 932 robots per 10,000 industrial workers. The corresponding figure for Singapore is 605 and for China 246 and, above all, growth is fast all the time. The robot density in Finland is 152, and no strong growth is in sight, as elsewhere in Europe. (Automation bus 2021, statistics 2021). This sets Europe at great risk of being marginalized in industrial production. The East- Asian countries have joined

the more mature stage of digitalization. This means that there may not be prejudices about digitalization in those countries, as in the western countries. They have seamlessly jumped over the rigid and expensive connections and applications directly into the world of mobile data transfer. The barriers of lack of expertise as well as unwillingness to commit to a long-term Industry 4.0 strategy or to invest in technology that could soon be obsolete (Moeuf et al. 2020) can be recognized in Finnish SMEs as well. This leads to another future challenge for increasing SME participation in these innovation ecosystems, both as solution providers and solution utilizers. Due to their limited resources and ability to take risks, SMEs need implementation support to exploit and to explore Industry 4.0 opportunities, as observed by Khan et al. 2020.

4 CONCLUSIONS

The purpose of this work was to look for barriers to digitalization in Finnish SMEs and thus their readiness to develop in line with industry 4.0. Most SMEs are entrepreneur-driven. Their financial and professional resources are limited. Especially in Finland venture capital funding doesn't often find SMEs, not at least manufacturing companies. In most cases, they provide a service or product to their own industrial customer, without direct contact with the end customer. This leaves them out of the data mainstream, without real-time information about the market. However, in addition to smart factories, Industry 4.0 includes the management of entire supply chains and product lifecycles. This makes the integration of SMEs into digitalization very important. Sustainable reuse and optimization of material use are also industry 4.0 goals. SMEs play an important role in all these activities. They have significant expertise in their area of expertise and there are many players, especially in services.

SMEs face several challenges in digitalization. Development costs and because ready-made applications may not be directly available, deployment and maintenance take time and money. A small company does not always have the opportunity to recruit specialists, and they are not always attractive alternatives enough for experts. Exploiting digitalization requires a company's management to be able to see the business opportunities it offers. This is limited by the company's management's own expertise. In addition to financial and knowledge constraints, SMEs also face business-related barriers to digitalisation related to the substitutability of a small player in the supply chain. This poses a difficulty for the transparency of information. In addition, when business continuity is uncertain, higher investments are a risk to business continuity. In addition, when solutions are not standardized, each customer may require different software and solutions for interfaces.

To take full advantage of Industry 4.0, it would be important for larger companies to take better account of the situation of SMEs when developing their own business. This is because it is indeed the only opportunity to develop complete production chains, manage the life cycle of the product and take environmental issues fully into account. This

requires later-stage private equity investors who focus on manufacturing companies. SMEs also need longer contracts to create peace of mind to secure investment. Training is important, but especially training for the company's senior management, board of directors and entrepreneurs. As awareness of the opportunities offered by digitalisation grows, declines the associated fears and risks. Business models and role models are particularly important to reduce the amount of implementation work in companies. Even if every company thinks they are just unique, their processes are not.

The most interesting study was a study in Portugal on managing the opportunities for the digitalization of business management. (Azevedo et al.2021). This study saw the needs of corporate management for additional training. The training was carried out with the help of a learning platform that enabled flexible study both in terms of time and in terms of the subjects chosen. Already existing self-assessment digital maturity online tools were used as a tool understand the situation of the companies. This would also be an interesting research topic in the Finnish SME field. VTT has created a digital maturity tool in Finland. It allows a company to test its own level of development in digitalization and the level of maturity compared to other companies. The tool is freely available at <https://digimaturity.vtt.fi>. The 6 main dimensions of VTT's DigiMaturity tool include strategy, business model, customer interface, organisation and processes, people and culture, and information technology. This helps the companies to find development areas needed.

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