AI utilization in Finnish SMEs – AI Boost project research report

Tikkanen Joonas, Al Natsheh Anas, Gbadegeshin Saheed, Gray Ashten, Rimpiläinen Antti, Ghafel Kawtar, Kuoppala Antti

AI utilization in Finnish SMEs –

AI Boost project research report

Tikkanen Joonas (KTM),

Al Natsheh Anas (FT),

Gbadegeshin Saheed (KTT),

Gray Ashten (LuK),

Rimpiläinen Antti (KTM),

Ghafel Kawtar (KTM),

Kuoppala Antti (KTM)

Contents

1   Introduction

This research report has been written as part of the Kajaani University of Applied Sciences` (KAMK) AI Boost project (ELY funding for the development of companies' operative environment in the European Regional Development Fund). AI Boost is included as one of the CEMIS (Centre of Measurement and Information Systems, www.cemis.fi) projects between 2020-2021. The AI Boost project aims to create new knowhow and understanding on how companies in Finland are utilizing artificial intelligence (AI) in their activities. The project aims to clarify the drivers and challenges related to deploying AI for small and medium-sized companies. In addition, the pur-pose is to identify how AI utilization can impact company strategy, turnover, and results. Addi-tionally, there is the target of understanding how companies can create new business, increase current business, and make operations more efficient, through AI.

The project need arose from the generally recognized need in the Kainuu region, and elsewhere in Finland, to find ways of increasing digitalization, as well as the testing and deployment of AI in SME-sized companies. In addition, the project implementers, the CEMIS Business Development unit (CBD), have previously recognized many challenges for startups and SMEs in creating enough income and efficiency to run international and managing increasingly global operations. Using only traditional manual means of operations leaves too much of a burden on individuals in small companies. Even though Finland is generally technologically advanced, including in the deploy-ment of AI, only 3,15 percent of Finnish companies with over 5 employees utilize AI on daily basis (SP6).

In Kainuu, the level of digitalization and the speed of AI deployment in SMEs can be improved. This has been reflected in findings from previous regional projects, such as Kainuun Digitie and Core Competence Development (CCD), as well as in how strongly it has been emphasized in re-gional development funding programs. Digitalization is required practically from all micro and SME companies today, while deploying AI in a disruptive, innovative way is seen as one of the key means to impact global business (SP3). New means of increasing the use of AI and other means in the wider concept of digitalization in SMEs, are required in the region. Companies who do not utilize any AI are expected to face hard competition in the future, according to many sources.

It has been seen by CBD that there is a favorable environment for AI utilization in Kainuu, where many SMEs have been innovative during the pandemic, and we believe many firms can be further supported through new projects and digitalization initiatives. This report can, for its part, demonstrate how companies can think of creating new business through AI, and an important target for the project is to disseminate the new knowhow in the region. The infrastructure in Kainuu is already strong with both KAMK and CSC having supercomputers available, and more research is planned to determine how local business life can best benefit from these resources.

This view has been emphasized in discussions with AI field experts around Finland and the need for this study was strongly validated by these interview discussions. In Finnish SMEs, expertise and use of digitalization and AI tools has yet to be deeply embedded in their culture (SP6). Also, many AI-related pilot projects and tests do not lead into the production level and companies may drop out during the process (SP1). This increases the need to initiate and try sufficient new openings and AI pilots in SMEs through regional research and development support. An expert (SP5) has also estimated the lack of technical expert staff as a significant hinderance in Finland, as expertise from various areas in relation to AI, including legislation and computer science, is demanded by companies in addition to core technology and programming skills.

This research report is an important output by the project to respond to its goals. The report is based on both a secondary study on academic and business sources, as well as its unique primary study. The following chapter discusses how this report was compiled, while chapter 3 focuses on secondary material related to the topic and research questions. Chapter four answers the research questions based on the project's primary research findings. Chapter 5 provides some conclusions and recommendations, and chapter 6 outlines noted limitations of the study and potential avenues for further research.

The primary study in this project has largely been conducted through interviews of SMEs who utilize AI. Part of the interviewed SMEs are AI providers whose businesses are chiefly based on AI

solutions, while others are companies that utilize AI to improve existing products or AI solutions/software provided by their suppliers. AI providers were included as they are most advanced in the use of AI and could therefore be expected to extend and share the most expertise on the topics. Previous research in Finland has sometimes covered AI use in general SMEs, per region for example, so considering SMEs with AI as a core part of the strategy was expected to give a new dimension.

Thus, this report aims to provide new insight into the AI phenomenon, particularly for regional SMEs. It brings a closer, more discussive perspective in comparison to some nationwide studies, to encourage new initiatives, testing, and deployment of AI technologies in Kainuu-based SMEs in the future. CBD will be happy to extend on the findings of this report and discuss the project research in more detail with all regional and national stakeholders. CBD contact details are attached to this report.

2   Research methodology

A mixed research method was used in this project. This method is suitable for a study that aims to develop new knowledge on a specific phenomenon (Creswell., 2009; Erickson & Kovalainen, 2008; Johnson & Onwuegbuzie, 2004). Likewise, the method is useful for convergence, complementary, and expansion of existing knowledge (Palinkas et al., 2011). Often, the use of the mixed method consists of only qualitative and quantitative research methods. Meanwhile, the mixed method can contain the use of two or more approaches, methods, instruments, and concepts in a single study (Johnson & Onwuegbuzie, 2004). Therefore, this project used a literature review and qualitative research methods.

A literature review is relevant when a study focuses on trends and points of view on a topic. The review helps researchers to know what has been done and what is going on in a topic (Denyer & Tranfield, 2009; Petticrew & Roberts, 2006; Tranfield et al., 2003). The literature review also enables the researchers to identify key themes, debates, and discussions on a topic (Steward, 2004). Most importantly, the literature review integrates different and related research works, as well as provides key knowledge on a topic (Torraco, 2005; Steward, 2004). On the other hand, a qualitative research method is relevant when a study needs to be investigated in its natural environment. The method enables researchers to have an in-depth understanding of a topic. It also enables them to use different materials, analyze them and interpret their findings (Creswell., 2009; Erickson & Kovalainen, 2008; Yin, 2003). In respect to the importance of both methods, this project combined them purposely to achieve its goal.

According to Denyer and Tranfield (2009) and Petticrew and Roberts (2006), literature review comprises defining search terms, selection of databases, searching of literature materials, pre-reading and selection of relevant materials, analyzing literature, and presentation of outcomes. Accordingly, the process followed. The search was defined by focusing on "Use of AI in Business", "What is an AI" business" and "AI is defined as". The first searching was done focusing on "Use of AI in Business" and the search was done on ABI (Proquest). This database was selected due its accessibility. Then, the literature search started with a time frame of publication which was between years 2010 and 2020. This period was selected purposely to obtain recent and sufficient

scholarly materials for this project. From the database, thousands of materials were found, but pre-reading enabled the authors to reduce the number to those most relevant. One hundred and twenty (120) were selected that consisted of articles, conference papers, book reviews and reports from recognized organizations (e.g., MIT). Most of the selected materials are recent around 3 years ago. The selected materials for this project were read in full and sixty (60) of them were chosen for further review.

The second search focused on "What is an AI" and "AI is defined as" terms. The Google scholar database was used. After pre-reading, 188 materials were selected, but after full reading, 55 of them were selected. Altogether, 115 literature materials were chosen from both searches. The chosen materials were analyzed with a thematic analysis tool. This analysis is recommended by scholars, such as Torraco (2005), and Steward (2004). Then, the findings were outlined.

For the qualitative method, interview was used to collect data. Some scholars, such as Creswell (2009), Erickson and Kovalainen (2008) and Yin (2003) recommended that interviews are suitable for qualitative studies. These scholars argued the interview enables researchers to access relevant data. In this project, an online interview was used due to the Coronavirus pandemic. About 53 organizations were contacted, based on a secondary search into Finnish market companies, and but 25 people from these organizations were able to participate. These participants were grouped into three categories. The first category was experts. They represented different Finnish organizations that are strongly involved in many AI activities in Finland. The second category was AI solution providers. They represented Finnish AI companies that provide different AI solutions, either to local companies or internationally. The last category was the AI solution users. They represented the companies that used AI in their operations.

THE STUDY PARTICPANTS

Study participant (Anonymous code)	Position of SP	Category
SP1	Head of AI project	Expert

SP2	Head and Member of AI programs	Expert
SP3	Vice Director of AI organization	Expert
SP4	Director of AI organization	Expert
SP5	Head of AI project	Expert
SP6	Director of AI organization	Expert
SP7	Head of AI and Analytics	AI solution provider
SP8	CEO	AI solution provider
SP9	CEO	AI solution provider
SP10	CEO	AI solution provider
SP11	CEO	AI solution provider
SP12	CEO	AI solution provider
SP13	Regional Sales Manager	AI solution user
SP14	CEO	AI solution user
SP15	CEO	AI solution user
SP16	CEO	AI solution user
SP17	CEO	AI solution user
SP18	CEO	AI solution user
SP19	CEO	AI solution user
SP20	CEO	AI solution user

SP21	CEO	AI solution user
SP22	CEO	AI solution user
SP23	CEO	AI solution provider
SP24	Head of AI	Expert
SP25	AI Lead	Expert

The study participants consisted of professors, chief executive officers, head of AI projects, head of AI department and regional sales manager. The main interview questions were based on the goals of the project. The average duration of the interview was 45 minutes. All interviews were recorded. Most of the project staff participated in the interviews. The interviews were summarized in terms of notes. These notes were analyzed via this procedure – codifying each note, compiling the codes, identifying themes from the codes, grouping themes, renaming the themes, and presenting the final themes. This procedure is also known as thematic analysis, and it was conducted in accordance with Eriksson and Kovalainen (2008) and Braun and Clarke (2006) recommendations.

3   Introduction to AI utilization in SMEs

3.1   Global markets

The development of the global market for AI-supported solutions looks to continue strong within the next five years, and the overall global AI market value has been estimated at 62 billion USD in 2020 (Grand View Research, 2021). One report studied the market revenue growth of the global AI software market and that is expected to continue at a compound annual growth rate of 41.6% from 2019 to 2025 (Frost & Sullivan 1, 2020). A key feature of AI technologies, according to the report, is their capability of disrupting industries and creating gaps in the market between countries. Particularly AI`s capability of large data set analysis can lead to productivity increases and business growth. For example, in industrial cases, this can mean improvements in machine calibration and predicting malfunctions, as well as more accurately predicting how material supply may develop.

By empirical findings of this research, the majority of the interviewees support the estimation of continued market growth, and that AI is highly likely to be applied, like many other technologies, in most industries, even if there are many steps along the way. Often, questions are there to be solved before utilization, such as ethics and data privacy regulations, while many companies have to work with their data before utilization. AI technology has had some hyped periods before, but in the last few years, AI has been transforming to be a more permanent part of many large industries, while becoming increasingly recognized in others. Globally, AI application is increasingly strong in many major industries: healthcare, banking and insurance, law, retail, media and advertising, automotive, agriculture, manufacturing (Grand View Research, 2021), and education. As stated, there is much development still to come and many new opportunities can yet appear on the horizon. In Europe 2019, 23% of IT firms had AI implemented enterprise wide. Trials were still in place in 33% of the 1025 studied firms, 18% were on proof-of-concept level, and 26% were in early implementation. (Frost & Sullivan, 2021)

In 2018, Vistage Research published a study on AI application areas in SMEs. In that study, 52% of the replies stated customer engagement, meaning sales and/or marketing operations and lead processing, logging, and analyzing customer data. Another 44% mentioned business operations,

covering, for example, predictive maintenance for machinery/equipment, routine task automation, and process control functions. Talent management and hiring were mentioned by 20% and the final main category was financial reporting which 16% of the companies mentioned. In talent management, AI can support by providing better data to the decision-making process and targeting the right candidates now and in the future. Some applications can identify the right characteristics, for example in a marketing position. (Vistage, 2018)

3.2   Finnish market

Finland is a relatively advanced AI country, and there are some extensive studies on this viewpoint including work by First Artificial Intelligence Accelerator FAIA (FAIA, 2020), Tieto (Tietoevry, 2019), and Turku Science Park (Turku Science Park Oy, 2019). The FAIA report also studied some previous work by VTT and KiraHUB. These earlier surveys had identified that firms primarily wanted to use AI to understand big data, and that in the majority of applications, some sort of data is needed in the use of AI. FAIA studied the company functions where AI is being implemented and in most cases (56.6%) AI was a part of product/services. AI as part of the production was in 17.5% of the cases while back-office functions (like accounting, and financing) were mentioned by 16.2%. On the company operations, most quoted were marketing, logistics, and customer service. Over 400 AI startups exist in Finland, that either have AI components as foundational in their products, or products and services that are based on AI platforms or algorithms, and those that provide AI consultancy as their main business.

FAIA report (FAIA, 2020) identified several quite varying use cases offered by Finnish AI companies. These include, for example, invoice automation, optimizing port logistics, prescriptive analysis for pulp production, pattern recognition in clinical trials, and so on. The use cases cover many large industries, as well as technologies for smart cities, logistics, back office, sales and marketing. The report conducted in Turku region yielded similar outcomes (Turku Science Park Oy, 2019). According to the report, it looks like the Finnish market is producing AI solutions for a more varied set of use cases for industry scale, possibly even wider than the main AI industries on the global scale.

3.3   AI Technologies

The definition of what AI is, is discussed more in other parts of this report, but this part outlines some of the main classes of technologies considered under the AI umbrella, that somehow look to imitate cognitive capabilities and assist in decision making. These technologies can be complex and have sub-categories and overlap each other, but for the purpose of this report, are mainly outlined for the reader to recap when technology is discussed in later chapters.

Machine learning (ML): ML enables data analysis, learning, and prediction based on data. Typically, computer software is trained to identify some patterns in incoming data, such as machine operating data. Once sufficiently trained, the system can make predictions from data sets, like potentially upcoming malfunctions. (Frost & Sullivan, 2021)

Deep learning (DL): A type of ML technology which trains machines/software to interpret some high-level abstractions in large amounts of data, big data. DL often consists of multiple levels of ML utilized to find logic or solutions to problems. DL resembles a brain like structure or neural network. (Frost & Sullivan, 2021)

Natural language processing (NLP): NLP consists of applying pattern recognition technologies to understand human language. Language can be spoken or written, and NLP can interpret it. Many programs utilizing NLP can also respond smartly, such as chatbots. (Frost & Sullivan, 2021)

Computer vision (CV): CV is an AI technology that allows computers and systems to recognize and understand digital images and videos, and to make actions or recommendations to the user. (IBM, 2021)

Intelligent agents (IA): Intelligent agents are AI-boosted software programs that can autonomously make decisions or give a service based on their user input, environment, and data. Many customer-service chatbots, programmed with certain topics of information, are considered intelligent agents but there are also very advanced bots that can search across the internet for answers to almost any question by the user. (TechTarget, 2019)

3.4   AI Drivers

Growth in the wide range of AI technologies has been driven by multiple factors internationally. The mentioned increase in data and big data globally demands interpretation. While much can be done with more traditional rule-based software, challenges, such as making predictive analytics or image recognition, are too complex in many businesses' use cases to be solved by rule only. AI also enables some degree of human analytical skills, expanding in time the software`s capabilities of learning, analysis, and acting based on that, increasing efficiency. Particularly in software, AI can really optimize the programs which aim to find data patterns, reduce costs, or improve productivity, thereby often improving existing products and services. AI solutions can take up repetitive, long, or mundane tasks, freeing humans to more creative, complex, or emotional challenges, often much more motivating work and employee experience. AI enables the creation of new business opportunities, products, and services. Data integration and examination by AI can result in new insights to support organizational decision-making, from many different use cases. There are many valuable reasons for AI investment instead of only 1-2 standing out. (Frost & Sullivan, 2021)

A Clarion blog (Sureka, 2020) in 2020 also listed benefits of AI for SME businesses:

• Enhanced marketing

• Tools that support salespeople

• AI boosts customer engagement

• Competitive intelligence support tools

• Data security AI

• Insights from CRM and new level of customer relationship and integration

- Chatbots, communication capability 24/7

AI is arguably driven also by global technology trends that enable more and more wide and complex solutions deployment. Cloud communications are growing vastly which allows companies fast, secure, and low-cost access to AI apps, and this is complemented by supercomputers that have the power to process practically anything SMEs may have to do, such as predictive analytics from big data. Mobile devices and AI-powered apps are boosted by the increasing availability of 5G networks internationally. AI technologies are advancing in a number of directions which allow multichannel and expansive customer services and on-device intelligence in the future. Exponentially growing data globally is also a key catalyst for AI adoption. (Frost & Sullivan, 2021)

3.5   Barriers to the use of AI

As for the barriers, Frost & Sullivan identify the complexity of the technology and of building AI models. Data management can also be complex and certainly time-consuming. Limited knowhow is available and there is a limited amount of people who master the required technologies. Often users/customers may be concerned with security, privacy restrictions, and lack of access to data. Data integration between systems can be complex and also time-consuming to build, therefore stated as one of these main concerns. Some skepticism is often found regarding potential incorrect actions by the AI, considering, for example, a certain tendency to bias. (Frost & Sullivan, 2021)

These views are supported by the findings of the mentioned studies by FAIA and Turku Science Park. In Finland, some 21.3% of studied companies found AI use cases to be still unclear (FAIA study). Lack of data availability and lack of skills and expertise were also quoted with similar numbers. The mentioned integration issues repeated in the FAIA study (6.9%), were perhaps linked to the other issues in finding partners (6.9%) and trouble with testing and implementation (6.9%). Those also require funding, time and other resources (13.1%) ((FAIA, 2020)) Similarly in Turku region, many companies do not yet know how they might begin to test or implement AI in their companies (23%), lack of staff resources (17%), lack of knowhow (13%), and lack of finances (13%) are repeated. In a more general division, the challenges are found around data, knowhow, resources, or value and utilization. A certain share of companies, by this study 11.74% find that there is no added value or use case from AI to their business (Turku Science Park Oy, 2019), which

is understandable also considering there are many micro and small firms that do not produce data at all much.

3.6   AI use in marketing and customer support, AI in niche markets

In customer experience and support, there are always demands to be more productive and efficient, thus cutting costs. In large firms, vast amounts of interactions must be handled efficiently. One option for this is using human-machine interfaced solutions. More generally, AI can draw insights with a real financial value from customer data. AI can also boost the mentioned employee experience and make improvements that can empower people and perhaps reduce staff turnover, as in many countries there are also fewer employees available than before. The computing power is available to utilize even the heavier AI-supported solutions and many young people expect to use advanced software and technology at work. By 2025, 95 percent of all European customer interactions are expected to be supported by AI. (Frost & Sullivan, 2021)

On the other hand, particularly customer service data volume can be overwhelming for SMEs so vendors and supporting stakeholders are needed. A strength of the European market is the widening variety of customer experience-related offerings and software available, so many companies who have evaluated their needs to improve in this sector can expect to be catered to at a reasonable cost. Mobile applications, different digital channels, and workforce optimization can be combined in AI solution selection. More advanced analytical tools are becoming available to interpret the customer experience and operational efficiency. (Frost & Sullivan, 2021) Particularly in the European and international markets, technology solution providers are forming one category of the developing ecosystem. With these firms, AI technologies are solution features instead of core functionalities, and these firms can support specific business issues (PWC, 2021), sometimes for a chosen industrial sector (Kami Vision, 2021). Many startups are also in this group, so other small or new firms could now collaborate also with companies of similar size, rather than big firms only (PWC, 2021).

APIs, for quick and easy integration between communication platforms and business applications, is another area in demand. (Frost & Sullivan, 2021) System integrators can be seen as another category of companies in the developing ecosystem, according to PWC. (PWC, 2021)

Suitable channels for customer service are also required by those firms that serve more niche markets, perhaps internationally B2B market. AI-powered applications provide real-time visual knowledge bases and proactive recommendations to enhance agent decision-making and company-wide knowledge sharing. AI can enhance the customer data, product or service data that is coming in from the customer, in addition to the inquiries made by the customer, forming a more complete package for being always available. AI, therefore, allows the analysis of drivers and inhibitors of customer performance, while providing a fast response. (Frost & Sullivan, 2021)

AI tracking customer behavior (such as written message, spoken, facial etc.) or customer`s machinery behavior could be automized too. AI could instantly send a notification when a set parameter or sentiment happens, or, if not automatically sending it, suggesting action for the operator (Forbes, 2021). Simultaneously, the company would gather information on customer behavior all the time, while being fast in first response. In some niche markets, there may be slightly more customers who tend to repeatedly ask similar questions. In this case, some AI-supported chatbot tool could also function efficiently.

In the future for international niche markets, customer sentiment analysis solutions may come into use more and more. However, it can be argued that recognizing the sentiment from customer words or feedback may not always be extremely accurate, particularly when there is language translation in between. (Frost & Sullivan, 2021)

3.7   AI for new product development

AI utilization for new product development includes some different options. It can help humans produce better products and lower the costs in manufacturing and design, and even help save lives in the medical sector or by replacing dangerous jobs (Shanin, 2021). AI can provide smart manufacturing for new products, or it can be a foundation of a completely new product/service. In this case, sometimes AI development is a founding part of the entire company. These products are occasionally called "AI-firsts" (Bessis, 2018). They would not make sense without AI, which has been the focal point of their design from the beginning.

According to a recent study (MIT Technology Review, 2021), AI is however not a "silver bullet" for designing entirely new products. Product design and manufacturing also require engineering in the future. A significant finding has been that AI can lower the barriers of development, allowing exploration of many more design variances in new product design. More models can be simulated, and then the best ones can be proof built, or code can be transferred directly to production line systems. Particularly in industries where there are multiple regulations and demands, such as car manufacturing, this has been pioneered in an effective way. More generally in manufacturing, AI use cases and utilization is already extensively used globally in the design of new products (Columbus, 2020).

AI-founded products, particularly in software, look very simple to use in comparison to traditional rule-based software with maybe hundreds of functions, but underneath there is much more. The products with AI foundations are much harder to copy or emulate. If something like this is created for a substantial market and one recognizes which part of human work is replaced comfortably, there is a chance of disruptive innovation and success. In the choice market, AI must, really, solve the problem with demanded levels of quality, demonstrability, and reliability. There are likely to be challenges, both in keeping the product functioning and for customers not to become over-reliant on it. (Bessis, 2018)

Plenty of discussions have been around the AI phenomenon and how ready different industries are for it. Particularly the new products founded on AI raise discussion on the readiness of markets and transitional periods, but at this stage, one should not discount either option. Many existing products are developed through AI, which can be as good an option. (Bessis, 2018). This is discussed more in the next subchapter. Extensive discussion on the readiness between industries for AI adoption is outside the scope of this study.

3.8   AI for developing existing products

The majority of companies internationally use AI applications that have been developed by a third-party vendor (39%). Quite often the vendor is combined with in-house development (30.2%), but encouragingly, a fair number of companies also develop AI applications themselves

(29.8%). (Frost & Sullivan, 2021) In the past few years, many existing products, particularly software, have been adding AI features. These are sometimes called "AI-Inside"s (Bessis, 2018).

An important question in improving products with AI is recognizing how much fault is tolerated in its use. Biases or other issues causing mistakes for customers is one issue to consider business-wise, but potentially life-threatening problems in other fields are even more pressing concerns, often quoted in the case of developing autonomy to transportation. This can exist both in entirely new products and developing existing products.

Reasons and rationale behind AI lead software recommendations or similar are increasingly needed. It needs to be visible or available to users to see how the recommendation or action has been taken and based on what. Complementing human work, AI can help make more consistent and faster decisions with better overall accuracy. (Accenture, 2018)

3.9   Impacts of AI on SME's strategy, turnover, and earnings

For SMEs to deploy AI, strategy is described as one place where to begin the planning process. A company that can recognize the strategic steps that it needs to execute well and to help one grow, should think if there are applications for AI that can support the successful execution of the strategy. For the SME applications of AI, it has been written that automation, image/face recognition, natural language processing, data analytics and predictive capacity are the main business applications (OECD, 2021). For SMEs, this can include strategic planning on:

•   Do you have something that you need to measure, that matters going forward?

•   What types of data there is in relation to the business?

•   Can you collect more data and/or digitalize more data?

AI prefers lots of organized data and if something is important for your business, it should be measured. Kia Tolppanen from Telia (2019) reinforced this for companies: "Begin thinking directly

from strategy. What are your meters, and what do you want to achieve? Then move to implement different proof of concept trials, and on to production."

AI can be sourced or built to provide the solution for that specific, often data-heavy problem. AI is a technology, not something that one should especially worry about more than using traditional methods. (Vistage, 2018) Many firms utilize vendors or other external support to work with the data and to create/import the AI solution. Difficulties may come in the form of biases, relying on bad data, and how to explain how the algorithms work, being transparent (OECD, 2021). Ethics of data use are a consideration where expertise will be valuable as well.

For SMEs, the positive impact of AI can be summarized into two issues: AI may alter the business environment and ease the operating conditions or enable change in business models or business practices. (OECD, 2021)

AI's impact on the results of SMEs has been hard to estimate, and productivity gains and return of investment have been difficult to assess (OECD, 2021). However, as more and more case examples are published, many SMEs in different sectors and specific cases can already find lots of benefits to relate to, particularly efficiency gains in production or other processes, that lead to less use of manual labor and save costs and often increased safety and ecology of operation. The full economic impact of AI on companies is yet quite rarely measured or publicly available. In a survey of 68 companies in central Europe only 5 percent were said to measure the AI impact internally (Bunte et al, 2021).

Some of the major technologies supported by AI, and some business operations, have been studied on the impact question. McKinsey found (1400 studied firms of varied sizes) that automation leveraging AI and other technologies creates labor savings of 20 percent or more and enables 24/7 operation with scale up opportunity. Quality control can be raised up 100 percent, depending on the case market demand. Within the study, deep learning AI cases provided additional value (compared to traditional analytics) between 30 and 128 percent (McKinsey, 2019). Then it depends on the firm size and industry, and how much that is in money.

The state of AI in Finland (2020) report outlines several use case examples of AI. Purchase invoices automation (machine learning) can handle thousands of invoices per month, saving on human labor time and costs extensively. Then, a process automation tool in customer service handles up to 86% of customer queries and provides over 500 extra hours of service. These will lead to clear financial benefits, though numbers were not stated by the study. One number that was given is for an AI-powered optimization tool for airport flight operations: delays decreased by 61% and their duration decreased by 66%, resulting in 500 000€ monthly savings. In some cases, in which AI is used to automate manual tasks reduce the time spent by 97% or more, so while a human would spend an hour in a process, the systems spend only less than 1 minute. (FAIA, 2020) That is an hour of salary saved in every case, and the human gets to focus on making the final decisions, and per year extensive hours and money are saved.

In secondary sources, much focus on SMEs AI adoption also leans towards marketing and sales processes support and automation. AI-supported paid online searches and intelligent google advertisement solutions are quoted to save SMEs thousands of dollars per month in search engine optimization costs. Demand forecasting solutions are also quoted, particularly for SMEs which do have to keep large warehouses and stock. (Remi AI, 2019)

Ville Hulkko, co-founder of Silo AI, (Telia, 2019) has said that it is not most fruitful for companies to approach AI adoption only through task automation, but when the process is built so that AI handles the heavy data amounts and alerts a human upon deviations, then it works. In the best scenarios, human work alters as little as possible, and AI becomes part of daily work. At first, Hulkko said, it is most important to recognize a business impact and what in relation to that can be possible to implement with today`s AI. Finding the first full use case should take time and be taken carefully and pragmatically, in order not to delay deployment for years on end.

4   Main research findings

This chapter focuses on outlining the main research findings of the empirical study in the project.

How do companies emerge or end up utilizing or deploying AI at the moment in Finland?

Many AI startups have roots in Finnish universities and other research networks. Universities AI and data analytics related research has been an important enabler in creating commercial AI solutions in Finland. In some cases, also the technology was developed within university research projects (SP9, SP17). Some companies were strongly based on the knowledge and competence of AI initially created within research networks (e.g., SP12). These companies were motivated to disseminate AI-related competence to industries and did not always, in the beginning, have a clearly defined focus on how to make business out of it (SP12).

Companies were also created when key persons had been working in AI and data analytics roles in the private sector and then started a new company. That professional experience accumulated competence and offered an obvious vantage point to find out companies' real-life problems worth solving and to understand the level of AI maturity in specific industries (SP7). This type of path often leads new companies to find their commercial focus much faster. Sometimes, as found in the interviews, research-based expertise or even technology takes more time to focus and develop into a specific business offering with a demand validated by the markets (SP17).

Companies utilizing AI in the core are not always based on AI and data analytics professionals seeking a problem in the market to be solved. Sometimes people working in another field of profession face practical issues and then find AI technologies that offer a suitable solution. As found in the interviews, some founders had experienced problems and challenges in contract management and patent analysis (SP15, SP20). Later they founded companies to solve those problems by utilizing AI technologies (NLP). One company identified how their industry data was extremely time consuming and difficult to collect in relation to the development of new products/solutions (SP22). Multiple decades long industry knowledge was the core when re-designing the whole process of research and development from hard to obtain datasets with help of AI technologies (ML/NN).

Some transformed from more general consultation business to data analytics and digital solutions. Later focus was shifted more to AI/ML related tailored offerings (SP10).

Sometimes, an AI-based company can emerge from a company sponsored competition. An arranged competition to solve a problem was the kickstart to the creation of one company (SP11). First, the focus of the new company was on offering just data visualization, which later changed to addition of AI dimensions (SP11).

4.1 Identification of customer needs – why is AI selected to solve them?

Most of the commercial AI solutions are so called human in the loop AI solutions where AI always requires humans to be involved somehow in the process of completing tasks. This results in AI being utilized in the complex automation of tasks and processes or simply augmenting the human's competence to solve tasks. Founders expressed many times that they saw some specific AI technology as the only way to solve the problem without human's input or when the task was too difficult and complex for humans to do manually. (SP9, SP16, SP18).

Augmenting user capabilities

- AI to interpret and make decisions (SP16)
- AI to provide insight and new information to assist humans in work (SP7)

Automating human's capabilities

- AI to more precise, faster, and cheaper operations (SP19)
- AI (NLP, speech recognition, CV, signal processing/ML, etc.) to automate human capabilities that are impossible for other technologies (SP15, SP12, SP20, SP21, SP18)

4.2   Definitions of AI

4.2.1   AI is beyond a specific technology

Both literature and empirical data showed that AI is not a specific technology. The data revealed that AI is a combination of various technologies. The data also pinpointed that AI cannot be described without considering different technologies, and even techniques in collecting, analyzing, and implementing data. This information negates the common notion that AI is just a computer system as it was explained by Haenlein and Kaplan (2019), Saravanan et al (2017) and Dautenhahn (2007). It is revealed from the analysis that Machine Learning (ML) is the common technology behind AI. This was previously claimed by Stewart et al. (2020) who stated that much of the discussion and reference to AI has been specifically focused on ML. The other technologies are Deep Learning (DL) and Natural Language Processing (NLP).

The data analysis revealed further that AI is built as a system in certain device or tool. Thus, the scholars and experts expressed that AI is a system that has the ability to do some activities. For instance, Goertzel (2006) described AI as a system that can achieve complex goals in complex environments as well as Wang (1995) defined it as a system that can process information and adapt to its environment with insufficient knowledge and resources. In fact, Adams et al. (2012) concluded that AI encompasses the development and demonstration of a system that exhibits the broad range of general intelligence found in humans. In a similar view, one of the experts said.: *AI is just computers or machines doing intelligent work or something that we consider to be intelligent. Something that would have required more persons to be involved*." Another expert gave an example of how AI could be used in very harsh weather conditions to collect data, analyze them, and provide information for people. Likewise, an expert cited an example of how AI (computer vision) could be used to detect components of equipment automatically from video and predict possible weakened parts, and when to maintain them so that the components could live long. All these examples showed that AI is not only an algorithm but also combinations of devices and technology to perform complex and complicated activities. (Gbadegeshin et al., 2021)

4.3   How is AI used in Finland by SMEs?

All companies interviewed for this research replied that they had AI as part of their core product or service, with full strategic and management commitment to the technology. This is essentially

what they use AI for. From a technology perspective, 11 companies utilize machine learning (ML) to different extents. Natural Language Processing (NLP) is utilized by 4 companies and computer vision (CV) by 6, while deep learning (DL) and neural networks were mentioned by 3. Some overlaps and combinations of these AI technologies were also in place in many firms, naturally, and importantly many also have multiple uses, outputs, or benefits. To summarize the finding, in all company cases the core product/service is software where AI technologies are used but sensors and other hardware are needed too. The software is connected to their target customer groups` business related processes, to the certain entity(s). The concept of AI and its features was discussed extensively in the previous question. In this research, several target markets were mentioned in total, such as industrial markets (8 mentions), security, medical (4), education (2), sport, media, and others.

The majority of the companies utilize AI to provide their customers with operational optimization through certain use case types. Some summarizations can be made for these types found in this research. The mentioned solutions help users gain predictive analytics from data, increase task speed, automate tasks, and/or do automated data analysis from statistics or other specific data. These summarizations, one should note, are made with an idea of what the solution is primarily doing in a very simplified form, while their benefits are further discussed in later questions.

Use case types recognized from primary data (generalized for privacy issues, some companies counted for more than one use case):

- predictive analytics from data (5)
- task speed increase (3)
- task automation (5)
- automated data analysis from case specific data (6)

For defining these cases, predictive analytics enables the estimation of "future outcomes using historical data combined with statistical modeling, data mining techniques, and machine learning. Companies employ predictive analytics to find patterns in this data to identify risks and opportunities" (IBM 2, 2021) in specific use environments. The task speed increase is essentially using AI solutions to operate tasks much faster than with previous technology and manual labor. Task automation similarly speeds up and makes it efficient to repeat tasks that take much longer to do manually or by existing solutions. Automated data analysis creates an output from potentially massive data which humans can follow up with and finalize, instead of working for a long time to reach the final analysis point.

"AI will take care of all boring tasks in all markets" statement by one entrepreneur (SP15) is one way of summing how AI could be utilized in the future, meaning heavily repetitive and manual tasks. AI utilization in the studied cases allows final decisions or follow-up actions to the user, the human in the loop as discussed earlier. Fully autonomous solutions were not recognized in this study, and some indication was found that many industries are not quite ready for them, or cannot have them for regulatory reasons, but this is not to state that such solutions may not be created more in the future, or that AI would not include them.

AI utilization outside the core product/service, such as in marketing, customer support, or product development, where some SMEs have utilized it according to previous studies, was implemented by 3 of the interviewed AI-founded companies only, though another 6 see themselves potentially doing that in the future. This result may be different if the target group for interviews was different, but many of the entrepreneurs interviewed for this study were unclear of the benefits of such solutions.

4.4   Challenges and opportunities to the use of AI in SMEs

The interview responses from the AI provider side yielded somewhat similar results as the secondary data review that was done for this project.

Data

Data availability and data quality are somewhat of a barrier to AI use according to the company interviews. It can be problematic in terms of quality, variables, location, cleaning the data, and checking what solutions are feasible. This requires working with customers. This was reflected in the expert interviews as well:

SP2: "the most important thing is that you need sufficient data, because otherwise you cannot train sufficient algorithms. You need labeled data. Lack of data is the issue why one cannot utilize AI in the business." "Companies plan how to get data and what data they need. It is part of their planning cycle. One needs to plan how to get data in the form when one can use it. Data cleaning is very important."

SP6: "If you try a tailored service, data quickly becomes a problem. In construction, for example, there is volume thinking and need so they do not invest in R&D but look to use semi-ready things

from the market. Also, SMEs should do this, look for readymade solutions as much as possible and get a feel for that. "

Human resources

As AI development is occurring in multiple industries and the use of AI is growing, there is a challenge to find the right human resources for developing AI solutions. One company also mentioned that finding people who understand both business and technology is a challenge. This could relate to the fact that a lot of development happens in close cooperation with the customer, therefore understanding the customer and the technology is necessary for the successful provision of AI. A company also mentioned that they have been also trying to hire junior experts as opposed to experienced PhDs since the technology is still developing and many do not have specific experience that they are looking for. SP5: "Shortage of technical staff. Expertise is needed from multiple areas, not only one, as the use of AI requires the collaboration of employees from different fields (such as law, CS, etc.) Need to know what the customer is looking for (in terms of solutions)." One expert, SP4 also mentioned that if there is no one in the company who understands AI, they cannot use the tools. The expert also mentioned two key challenges for companies which are expertise and the attitude of the companies.

Close end-user cooperation is needed

A healthcare related AI provider (SP12) commented that bringing a technology that has not been used before can be challenging. Some doctors for instance are more resistant when it comes to new technology as opposed to others. They have tried to work with the doctors "who are interested to learn better ways to work with their patients." Once these doctors have a better understanding of the technology they are talking to others. The lack of conferences in the medical field also is a challenge since there it has been easy to talk about the technology and give an opportunity to try it (SP12).

Customer expectations

Customers might also have unrealistic expectations on what AI can do for them or do not really understand what AI can be used for. This seems to create a situation where the provider and customer are both exploring what the use case and business impact are in reality. This seems to be similar to other cases of adopting emerging technologies where the customer needs to be taught how to buy. This could be done via proof-of-concept PoC and piloting cases. One expert,

SP5, also commented that "AI is still on the experimentation stage, trying to find solutions to problems but still on trial and error, uncertain of the results or effectiveness of the AI use case."

AI Hype

AI hype has been seen from different perspectives by companies. On one hand, seeing the word AI everywhere these days has generated a lot of interest in AI-based solutions, but the problem is that when the word becomes overhyped it saturates and might lose meaning (compare e.g. to the word innovation). Some companies would rather talk about a subset term of AI e.g. machine learning rather than AI. The focus also is more on the added value the AI brings and not the AI itself, for the sake of AI.

COVID

COVID has also caused some barriers, but it has worked as a driver as well. Lockdown has required almost instant adoption of certain remote work technologies and for example, one AI solution provider provided a case example of providing a digital training platform for a customer in ten days to 16 training centers.

4.5   Marketing and customer support with AI, AI for SMEs in niche markets

As presented in the previous section outlining the secondary research that was used as a foundation for the interviews, artificial intelligence has been successfully utilized by enterprises for marketing and customer services purposes. To better understand this phenomenon in the Finnish context, the companies interviewed were asked about the topic and if their company uses AI for those purposes. It should be noted that two companies, SP14 and SP33, had time restraints and shorter interviews were arranged where this question was removed from the discussion.

The responses were fairly consistent from all of the respondents. There was a sound understanding of the capabilities of AI in marketing and customer service contexts. SP15 strongly agreed that these are "lucrative markets for AI", elaborating that, "AI will take care of boring tasks in all markets." Despite the consensus on the opportunities of AI in marketing and customer service, only companies that provide AI services in the realm of marketing and customer support reported using AI for these objectives. SP10 is an AI service provider that promotes AI as a customer support solution, saying that their "clients do not need to spend so much time on individual clients", allowing for time savings.

Six interviewees said that although they do not currently use AI for these purposes, they may in the future. The reason for this is scale. As SP11 described, "maybe in the future, a wider audience may be relevant." The rationale was the same as those who said that AI for marketing and customer service was not in their foreseeable future. SP9 said that their customer market was smaller and niche, and because of this, direct communication was preferable. Others also described their customer market as niche and felt that one on one communication was more successful.

Those who said that they may use AI in marketing and customer services added that they would most likely purchase those applications from another company that specializes in those fields. The reasons cited for this were the time and resources of developing AI for new purposes, the amount of data needed to train the AI, and the expertise that a specialized company has.

The interviews overall showed a pattern of understanding that AI utilization, as SP12 put it, "should come from solving a problem." The understanding of AI use for marketing and customer service follows the same pattern. AI has the power to solve problems, but it is not always the right answer. Despite not touching on the topic directly, the information given by the AI experts supported this.

4.6   How AI can be used for new products and services development?

In answering this question, 50% of the company respondents (SP7; SP10; SP12; SP15; SP17; SP19; SP20; SP21) agree with the statement, strongly endorsing that AI can create completely new products and/or services. However, while half of these interviewees provided some kind of justification supporting their claim, the other half endorsed the statement without further clarifications, leaving an open-ended debate as to the feasibility of this question on real grounds. For the first group, companies such as (SP10 & SP20) argued that AI can provide advanced insights from existing solutions and/or data, and consequently, a deeper understanding of how the current products would be further developed, improved, and based on that identify the required development areas for future products.

Interestingly enough, this same line of thought was raised in justifications of companies disagreeing with the above statement, and thus attributing AI's ability to improve products as a complementary, rather than a radical way of designing products/services. For instance, (SP12) mentions that companies cannot just solve a problem from scratch using AI, but rather improve existing

solutions by incorporating neural networks, or what (SP9) called "extending" on the product. Similarly, (SP8) adds to the latter debate with a metaphor, whereby AI's ability to enhance existing product capabilities is compared to "how innovative a company is in designing stronger structures/frames with less materials…related to mechanical, statistical and structural problems". At this level, it is worth mentioning that the product itself is as strong as the AI algorithm and data backing it. If the learning material is of poor quality, weak or biased, this will be reflected in the product as well (SP8).

4.7   How AI can be used for improving existing products and services?

In support of this question, a general trend of answers could be witnessed from interview responses. As such, an aggregate of 81% AI providers interviewed reinforced the discussion of artificial intelligence supporting existing company products/services through planning and/or industrial process optimizations (SP7; SP11; SP18), automation of routine and/or labor-intensive tasks (SP15; SP16; SP17; SP18; SP19), sophisticated tasks requiring advanced computational capabilities (SP9), as well as maintenance or quality management tasks (SP8; SP10; SP12). At the other end of the spectrum, companies like (SP8; SP10; SP13; SP18) bring about AI's capabilities to enhance customer services and/or support, or even scaling abilities with regards to meta-data analysis (SP12 & SP14). SP11 sums up the trend by arguing that "all current projects are either related to data analytics, visualization, processing, and/or automating things". For processes, automation and scaling of huge amounts are in the core (SP22). Instead of taking millions of manual calculations, AI's neural network has not only a faster execution but a more accurate (SP18; SP20; SP22), efficient, and objective one compared to human work (SP 14 & SP16).

Digging into the deeper answering layers, the first trend – concerning planning optimization – can be seen in intelligent traffic management and autonomous cars (SP5), or even maritime logistics and transportation (SP7). Accordingly, AI is able to support maritime stakeholders (and users of the web/mobile Apps) with efficient planning, scheduling and operations lead whereby applications provide the widest picture to the specifics of large storage and cargo areas, automating the monitoring of the latter. In addition, AI plans customer schedules and connects them to the cargo storage predictions to calculate with accuracy estimations on aspects like when users need to start cargo operations (in hours of a specific day) and when the ship or cargo will arrive precisely (SP7).

A second trend relates to the automation of tasks and/or company activities. At this level, respondents specified AI's ability to support existing company products by automating routine tasks, such as administrative processes related to contract management, or general document management (SP15), human resources tasks such as using AI to search for potential candidates, and optimize the recruitment process (SP19), or more labor intensive operational (work-related) tasks (SP16 & SP17).

Primary case examples brought about by companies (SP16 & SP21) pertain to the health sector, and more specifically to medical recording or transcribing. For instance, doctors traditionally needed to ask for the electroencephalogram (EEG) recording – a recording of brain activity detecting abnormalities in brain waves, or in the electrical activity of the brain – externally from a nurse in a different department, which was a resource and time-draining process. AI has made it possible not only to take brain activity measurements immediately and throughout longer time periods, but also to follow the brain function in the most challenging situations, such as under sedation, brain trauma, or cardiac arrest (SP16). Transcribing medical prescriptions has also been a challenging routine for the health sector, and according to SP21, AI is now capable of supporting transcription work by automating the latter, resulting in 400-500% more efficient transcription, with 95% accuracy and real-time speed recognition of just 0.2 seconds. The process, traditionally taking up to seven days to be performed by average humans, is now delivered within 24 hours. Automation of routine tasks has also affected the music and entertainment industry, with AI performing automated audio processing for programs, podcasts, recording, and AI-based audio quality editing (SP18).

A third trend pertains to maintenance and/or quality management support. Under this line of thought, (SP8) argues that AI made the product more competitive in the global arena through automation of maintenance testing, quality control, and quality management testing, all of which are significant activities in the industrial sectors. (SP10) adds to the discussion by providing an example of different computer vision-based apps for detecting faults in electrical components from end video images and automating inspection works for clients. Automation of such critical industry processes enhances industrial quality control and inspection by providing an "affordably-integrated" machine vision in industrial machinery (SP12).

A fourth trend under the AI-supporting products/services umbrella lies in the latter's ability to automate complex and sophisticated tasks, usually requiring advanced predictive analytics. A case example raised in that regard pertains to the Meteorology sector, namely "weather forecasting and predictions". (SP9) stresses AI's role in recognizing complex weather-related patterns

(such as Clouds) and providing faster and more accurate weather forecast updates in about every 10 minutes. This is particularly important information for decision-making for companies and individuals living in coastal American cities under the constant threat of a hurricane storm. Thus, a need for buying an appropriate insurance backup cover is necessary and the existing accuracy in the AI predictive systems allows companies to better quantify the risk of what will exactly happen and accordingly calculate the insurance price, estimate damages, etc.

Last, other companies emphasized AI's scaling ability in analyzing meta-data, be it images (SP12) or content from digital learning environments (SP14). In the former, (SP12) discussed the role of similarity search in image databases in making stronger and more competitive products. In fact, the company mentions that "anywhere where you have lots of information, you have the chance to use AI to your benefit. Within our machine vision system, we are looking now to build search features for the thousands of images collected from production…making products more competitive in scaling". Also called "visual search", "visual similarity search" or "image-based search", this AI-enhanced capability is backed up by advanced machine learning and computer vision technology in the background, which scrutinize the product/image inventory, analyzing shapes, colors, and patterns and returns results that are visually similar to the reference image provided by the user (Toncheva, 2019). Thanks to AI, visual search improves product discovery, delivers where text search fails, increases conversions, and decreases shopping cart abandonment while also offering rich media experience to users (Toncheva, 2019), especially for retailers and e-commerce in general.

In industrial settings, duplicate product content detection enables content-based product recommendations, which could leverage product similarity to recommend alternative items with the same characteristics for products that are out of stock. In addition, it can assist enhancing data information: if some product data lack certain attribute values, it is possible to suggest potential attributes that are found in its most similar products (Lazaridou, 2018).

Finally, aligned with the meta-data scaling analysis, (SP14) discusses AI's contribution to the educational sector through digital learning environments. As such, AI support educational activities by having machine learning algorithms analyzes with scrutiny all student interactions online, including any thematic issues raised in the digital platform, comments, topics learned, highlights on learning materials, or even sentiments derived from discussions, resulting in a "student profiling", clustering them into different learning tribes based on distinct learning recommendations and/or characteristics.

4.8   Impacts of the use of AI on company's strategy, turnover, and earnings of companies and their customers

All the firms interviewed in this project have AI at their core. Therefore, AI is also very essential to their strategy, and their earnings are heavily based on their AI-supported products/services. This was confirmed specifically by a number of firms.

Some of the interviewed firms stated that, in their opinion, AI has the most potential for companies that have a lot of data in several processes that could be utilized. Therein, the AI utilization would have some impact on the strategy of those firms, and by estimation, also have a positive revenue impact: "Artificial intelligence and neural networks, they are like a way to make better decisions or faster decisions, improve processes, business processes. So, then you would want to, in a strategic way, look at your business processes, where you have a lot of scale, a lot of data, and the decisions over those processes are financially impactful." (SP12) It was also stated that "AI, definitely it affects business outcomes positively. Makes things possible that were not possible before, but I see it simply as one technology and one should start from the business goals, and if there are AI methods to achieve that, then great." (SP18)

"There are not many structured outcomes documented from previous AI projects by companies considering the AI impact on, for example, profit", an industrial expert (SP1) stated during the interview. Similarly, another professional in this field (SP2) mentioned that "[the] business value of AI projects is often difficult to estimate very well." On this question of earnings and profits, the majority (15) of the interviewed firms serve their customers by optimizing some operation that saves time and cost, which contributes to their profits. Increasing the speed of previously manual operations can be an important part of this and was specifically mentioned by six interviewees. Seven firms specifically cited improving the quality of the user experience, while ecology or environmental benefits were mentioned by two firms.

Importantly, six of 16 firms were able to quantify some of the financial impacts of their AI solutions. This finding added to the existing research (e.g. State of AI in Finland, 2020). AI, on average, reduced their customers` existing manual processes time to around 5-15 percent of the original time spent. To give an example, this means that 5-6 hours of paid human labor can be handled by a solution in 15 minutes. Automation of tasks can therefore free up e.g. 4 hours of working time of an individual, or 85 percent in other terms, even per day. These cases should have a positive direct financial impact on the user company. This study also showed that such solutions exist both for employee level and expert level positions in different industries. This allows for much

more time on creative and demanding tasks for humans, increasing the motivation and well-being of these individuals.

To extend with some single examples from the empiric cases, one company (SP11) estimated 500 000 euros annual savings in a case of early alert to a customer process issue which their AI-supported solution recognized. Another company finding was that a middle-sized institute in Finland may save up to 1 million euros per year from AI-based task automation (SP21).

For the extent of this research, it can be estimated that AI solutions will save enterprises' resources and money, leading to better profits. SP3 estimated that "Utilizing AI properly could add 20 billion euros to the Finnish economy. Who will get the profits in the game? I do not think it will be companies who go in minimal but those who go to disrupt and do something innovative which is very hard to do." In cases where SMEs are not able to build their own solutions, various AI as service platforms are available in the markets that serve two or multiple tasks with one easy-to-use service, and this option can and should be noted by SMEs (Barrett, 2019). Return on investment (ROI) in AI initiatives has at times been superb indeed in Finland. ROI of 5-10-fold has been found, which means that a 1-million-euro investment creates 5 million or more (SP25).

Positive impacts on results and strategic operations were discussed, as described, but interviewees could not shed more information on turnover impacts because that takes a longer time. Many AI projects in Finnish companies are not yet 3-5 years old, the time that it takes to evaluate the impact on potential company growth and employment more fully, SP2 observed. Some financial support has been and is currently available. In particular, AI-focused growth firms in Finland had collected almost 100 million euros in funding by early 2020 (Andersson, 2020).

5   Key outcomes, conclusions, and recommendations

This report has provided new insight into the AI phenomenon in Finland, with a particular focus on small and medium-sized companies. It provided insights into how AI-focused SMEs have been founded and why and how AI is deployed by them in their products and services. The report outlined some expert views on how AI can be used to improve existing products or create new ones. The definition of AI and its different features were discussed in the interviews and summarized in this report. The drivers and the barriers of AI deployment were outlined, based on both secondary and primary study findings with a special focus on the challenges of utilizing AI. AI`s benefits for SMEs and their customers were discussed in chapter 4.

This report provides some contribution toward the business impact of AI deployment, at least from the customer impact viewpoint. It was said in one of the interviews that the full economic impact of an AI project would have to be measured over 3-5 years (SP2). This is outside the scope of this project, and the same thing has been a challenge in public projects elsewhere. However, this study has also outlined a wealth of AI benefits with some contributions towards the economic benefits from its use.

Perhaps AI is not yet sufficiently marketed to SMEs. Some of the interviewed companies have not seen much movement toward AI from SMEs or may not see them as a target market. From the research in this project, we find that SMEs who adopt AI have a good chance to grow and gain strong market positions. Many of the AI expert firms have to train the SME markets and users and they may have much to learn, but this is a typical step in new technology markets and SMEs in Finland have an excellent opportunity to learn from discussions with the AI expert enterprises.

However, the opportunity to be among the first SMEs to benefit will not always last. An experienced researcher (SP3) has studied the Finnish economy on AI adoption: "We have faced a problem that companies are very different. There does not seem to be a rulebook. There are huge opportunities, but you need some work and investment towards that. Most investments currently go to machine learning and data usage. Low-hanging fruits are not there anymore soon." This view was earlier stated by AI writer Antti Merilehto (2019) who demands more AI piloting from companies in Finland. "If one has a chance to trial AI now, do it". According to Merilehto, deploying AI into everyday business life at a firm requires three things: data, knowhow, and time to experiment. Knowhow can be purchased, recruited, or trained. For purchasing, less than 50 000

euros is already a good start. Merilehto expects AI to change business fundamentals "in nearly all fields of business".

The project research showed that AI expertise is widely available for many use cases in Finland, and the companies who offer AI solutions have strong expertise and education, many with either a university background (9 in this report) and/or a wealth of technology business background (8), thereby supporting their customers` deployment processes strongly. For SMEs, AI trials, piloting, and deployment are processes that have several steps and can take some time (data collection can take up to 80 percent of the project time (Andersson, 2020)), but there is also some public funding, and university supported programs and organizations which can support pilot processes and AI deployment planning for SMEs. The diversity of AI use cases and technology opportunities were found very wide in this study, which suggests that SMEs across all industries should not discount the opportunities without taking an in-depth look first. The AI business opportunity planning and deployment are recommended to include both external expertise and company internal expertise (Myllymäki, 2020).

Ease of use of the solutions and quality of user experience were stated by a number of interviewees. These qualities can help SMEs who do not have deep expertise in AI technology or digitalization means. An AI ecosystem can be said to be in place in Finland for SMEs to deploy and utilize AI and belief in the future was indicated by the participants, from a number of perspectives. Firstly, companies that utilize AI can progress in ethics and transparency. SP4: "AI has a huge role to show clearly to customers what the company does. Also, companies that use AI have to be clear about what data they use and how they get it. Ethical and transparent companies have the upper hand in the transition to AI."

Secondly, based on the Finnish market experiences so far, it is considered that many SMEs are capable of quickly going into planning and initial testing. SP1: "The great thing about the SMEs has been the fast development of good ideas and into Proof-of-Concept plan, quick adaptation and rethink are very positive in many companies." Stopping dysfunctional ideas as early as possible is one key to good AI adoption as well (SP25).

Thirdly, the availability of solutions and platforms is already there: "There are lots of great AI companies in the market, and when the market learns to use AI more widely, it will be better for everyone." (SP21) SP6: "In construction, for example, there is volume thinking and need so they do not invest in R&D but look to use semi-ready things from the market. Also, SMEs should do this, look for readymade solutions (like Software-as-a-Services (SP24)) as much as possible and

get a feel for that." In essence, and in relation to what Kia Tolppanen from Telia has stated (2019), AI utilization would often be for strategic operations but does not necessarily change the overall strategy of SMEs. Rather, AI should be considered becoming a part of the strategy with some strategical adjustments, and not a separate bit on top of something in the company (SP25). Financially, ready-made solutions may be much more viable for most SMEs, paying a monthly fee for example (SP24), instead of a big up-front payment.

In addition, most AI providers validate the statement that artificial intelligence could support existing company products/services through planning and/or industrial process optimizations, automation of routine and/or labor-intensive tasks, sophisticated and/or heavy computations tasks as well as maintenance or quality management tasks. However, a debate is still ongoing on AI's capability to build completely new products and services, with viewpoints vacillating between an approval or refusal of the statement portraying a firm belief that AI is rather an extension or complement to the existing products/services.

The utilization of AI in marketing and customer support was discussed but not yet widely deployed in many of the interviewed companies. There was a clear indication in at least two interviews (SP12, SP23) that simpler, lower-cost automation tools often solve many of these issues for SMEs.

In our view, the findings in this research give a strong indication that most SMEs should inspect and look to pilot AI opportunities with a target to bring solutions to continuous use. This is supported by some recent expert opinions. Sam Salonen, senior business manager at Telia Robotics & AI, has stated that nearly all well-documented, specified processes, can be automized (Telia, 2019). A good starting point is a process that has quite little deviations and is quite secure. Different types of reporting, billing, and delivery processes are often such. In GDPR-related matters a robot can collect all the personnel data, no human intervention to personal data is required. At Telia, there is also a new employee package that is handled through robotics, robot ensuring that all tools and resources are in place for he/she on the first day on the job.

CBD unit at KAMK has networked with some of the AI experts in Finland and can support regional SMEs in their AI planning and pilot projects in the near future. This has been already piloted in some KAMK projects, with a strong aim to continue. More overall, the ecosystem in Finland is already in place for more SMEs to try AI initiatives and to increase AI deployment in their production. In Kainuu, we also have the infrastructure for cases that demand extreme computing power, as well as initiatives for data collection and pooling.

6   Further research and restrictions of the study

This report is much based on material from "AI in their core" businesses. Those companies who simply utilize AI for some other part of the operation, outside the main products/services, have not been interviewed much here and this is reflected in the findings. Therefore, the understanding of the deployment of AI into regular SMEs would warrant more study or surveying. AI-based marketing and sales support tools which some SMEs have been stated to utilize were less used by our interviewees and this area would benefit from more insights. An extended study of some companies that begin to deploy AI as users, with attention to their turnover and revenue, and comparing the starting point and later reference points, would add value to the study of the phenomenon in Finland.

An open issue revealed by this study includes a blurred understanding of and confusion about AI's specific capabilities in creating entirely new products and/or services. This is actually important to recognize as a result, and it leaves an open discussion and provides a basis for further investigation into the matter.

Another limitation of this study lies in the generalizability of the interview results as they mostly pertain to AI businesses and/or experts in Finland spanning different industries. A possible avenue for research could be to analyze the viewpoints on Artificial Intelligence use within the same industry and highlight potential trends and/or differences, for a more focused understanding of AI specific to one industry. Finally, results from this study could also be analyzed and compared with regard to similar studies conducted in other countries to witness any interesting patterns.

This research report does not particularly discuss ethics and GDPR-related data, which are always related to AI deployment and should be considered by all. This is mostly because of the existence of such knowhow in authorities and AI-providing companies that can support customers in this issue. The issue would also extend to another report on its own.

This research report can be shared to interested stakeholders in Kainuu and elsewhere. For KAMK and CBD, an important aim is to discuss the findings in webinars, events and meetings where local SMEs also participate. CBD will also be happy to utilize our network for local enterprises' benefit. Some of the project findings can be transferred to different training materials for KAMK projects as well as the brochure contents in the AI Boost project.

Sources

Accenture, 2018. Explainable AI: The next stage of human-machine collaboration. Viewed 25.08.2021.   https://www.accenture.com/id-en/insights/technology/explainable-ai-human-machine

Adams, S., Arel, I., Bach, J., Coop, R., Furlan, R., Goertzel, B., … & Shapiro, S.C. 2012. Mapping the landscape of human-level artificial general intelligence, AI magazine, vol. 33, no 1, pp. 25–42, 2012.

Albus, J.S. 1991. Outline for a theory of intelligence. IEEE Trans. Systems, Man and Cybernetics, vol 21, no 3, pp 473–509.

Andersson, C. 2020. Tekoäly tulee myös pk-yrityksiin. Viewed on 14.09.2021. Tekoäly tulee myös pk-¬yrityksiin | OP Media (op-media.fi)

Barrett, E. 2019. The value of A.I in SME, and what does it mean for me? Viewed on 08.09.2021.
         (1) The value of A.I in SME, and what does it mean for me? | LinkedIn

Bessis, D. 2018. Building AI-first products. Viewed on 25.08.2021.
         https://medium.com/@davidbessis/building-ai-first-products-90d503ccd43a

Bostrom, N. "Superintelligence. Paths, Dangers, Strategy". United Kingdom, Oxford University Press, 2014.

 Bunte, A., Richter, F., Diovisalvi, R. 2021. Why It is Hard to Find AI in SMEs: A Survey from the Practice and How to Promote It. Viewed on 27.08.2021.
         https://www.scitepress.org/Papers/2021/102041/102041.pdf

Braun, V., Clarke, V. 2006. Using Thematic Analysis in Psychology. Qualitative Research in Psychology, vol. 3, no. 2, pp.: 77-101, 2006.

Chartrand, G., Cheng, P.M., Vorontsov, E., Drozdzal, M., Turcotte, S., Pal, C.J., Tang, A. 2017. Deep learning: a primer for radiologists. Radiographics, vol. 37, no 7, pp 2113-2131.

Columbus, L. 2020. 10 Ways AI Is Improving New Product Development. Viewed on 25.08.2021.
         https://www.forbes.com/sites/louiscolumbus/2020/07/09/10-ways-ai-is-improving-new- product-development/?sh=3526476f5d3c

Creswell, J.W. 2009. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, (3rd Ed.). London: Sage Publication Inc.

Dautenhahn, K. 2007. Socially intelligent robots: dimensions of human–robot interaction. Philosophical transactions of the royal society, Biological Sciences, vol. 362, no. 1480, pp.679-704.

Denyer, D., Tranfield, T. 2009. Producing a systematic review in Buchanan, D.A. and Bryman, A., The Sage Handbook of Organizational Research Methods, London: Sage publications.

Eriksson, P., A. Kovalainen, A. 2008. Qualitative Methods in Business Research. London: Sage Publications Ltd, 2008.

FAIA, 2020. State of AI in Finland, report. Viewed on 20.08.2021.
        https://faia.fi/market-research/

Fogel, D.B. 1995. Book Review of Computational Intelligence: Imitating Life. By J. M. Zurada, J.M., Marks, R. J., and Robinson, C.J. Eds. (Piscataway, NJ: IEEE Press, 1994, 448 pp.

Forbes, 2021. 15 Ways to Leverage AI in Customer Service. Viewed on 21.12.2021.
         https://www.forbes.com/sites/forbesbusinesscouncil/2021/07/22/15-ways-to-leverage-ai-in-customer-service/?sh=21e0299620bb

Franenfield, J. 2020. Artificial Intelligence. Investopedia. Viewed on 15.09.2021.
        https://www.investopedia.com/terms/a/artificial-intelligence-ai.asp

Frost & Sullivan 1, 2020. Global Artificial Intelligence Software Market, Forecast to 2025. Market research.

Frost & Sullivan, 2021. Enhancing European Customer Experience with Artificial Intelligence. Market research.

Gbadegeshin, S.A, Al Natsheh, A., Ghafel, K., Tikkanen, J., Gray, A., Rimpiläinen, A., Kuoppala, A., Kalermo-Poranen, J. & Hirvonen, N., 2021. WHAT IS AN ARTIFICIAL INTELLIGENCE (AI): A SIMPLE BUZZWORD OR A WORTHWHILE INEVITABILITY?. Proceedings of ICERI2021 Conference, 8th-9th November 2021, p. 0468 - 0479.

Goertzel, B. 2006. The hidden pattern. Brown Walker Press.

Grand View Research, 2021. Artificial Intelligence Market Size, Share & Trends Analysis Report By Solution, By Technology (Deep Learning, Machine Learning, Natural Language Processing, Machine Vision), By End Use, By Region, And Segment Forecasts, 2021 – 2028. Viewed on 20.08.2021.

https://www.grandviewresearch.com/industry-analysis/artificial-intelligence-ai-market

Haenlein, M., Kaplan, A. 2019. A Brief History of Artificial Intelligence: On the Past, Present, and Future of Artificial Intelligence. California Management Review, vol. 61, no. 4, pp. 5–14.

Hall, W., Pesenti, J. 2017. Growing the artificial intelligence industry in the UK. Department for Digital, Culture, Media & Sport and Department for Business, Energy & Industrial Strategy. Part of the Industrial Strategy UK and the Commonwealth.

Hintze, A. 2016. Understanding the four types of AI, from reactive robots to self-aware beings. The Conversation, 2016. Viewed on 15.09.2021.   https://theconversa-tion.com/understanding-the-four-types-of-ai-from-reactive-robots-to-self-aware-beings-67616

IBM, 2021. What is Computer Vision? Viewed on 23.08.2021   https://www.ibm.com/top-ics/computer-vision

IBM 2, 2021. Predictive Analytics. Viewed on 09.09.2021.

https://www.ibm.com/analytics/predictive-analytics

Jakhar, D., Kaur, I. 2019. Artificial intelligence, machine learning and deep learning: definitions and differences. Clinical and Experimental Dermatology, vol. 45, no. 1, pp. 131-132.

Johnson, R.B., Onwuegbuzie, A.J. 2004. Mixed Methods Research: A Research Paradigm Whose Time Has Come. Educational Researcher, vol. 33, vol 7, pp 14-26.

Kami Vision, 2021. How And Why We Identify And Develop AI Models For Niche Cases. Viewed on 21.12.2021.

https://kamivision.com/blog/how-and-why-we-identify-and-develop-ai-models-for-niche-cases/

Laird, J.E., Wray, R.E., Langley, P. 2009. Claims and Challenges in Evaluating Human Level Intelli-gent Systems. In B. Goertzel, P. Hitzler, and M. Hutter (eds.), Proceedings of the Second Confer-ence on Artificial General Intelligence. Atlantis Press.

Lazaridou, E. 2018. Improving Data Quality with Product Similarity Search. Viewed on 05.09.2021. https://techblog.commercetools.com/improving-data-quality-with-product-similarity- search-d037c7212071

Lewis, C.W., Monett, D. 2018. Text analysis of unstructured data on definitions of intelligence. In Proceedings of The 2018 Meeting of the International Association for Computing and Philosophy, IACAP.

Martinez, R. 2019. Artificial intelligence: Distinguishing between types & definitions. Nevada Law Journal, vol. 19, no 3, pp 9.

McKinsey, 2019. Driving Impact At Scale From Automation and AI. Viewed on 27.08.2021. Driving-impact-at-scale-from-automation-and-AI.ashx (mckinsey.com)

MIT Technology Review, 2021. Product design gets an AI makeover. Viewed on 25.08.2021. https://wp.technologyreview.com/wp-content/uploads/2021/05/Product-design-gets-an-AI-makeover.pdf?_ga=2.39420643.1361193512.1629877315-1860966038.1629877315

Monett, D., Lewis, C.W. 2020. Definitional Foundations for Intelligent Systems, Part I: Quality Criteria for Definitions of Intelligence. Proceeding of the 10th Anniversary Conference of the Academic Conference Association, AC 2020At: Prague, Czech Republic.

Monett, D., Lewis, C.W. 2018. Getting clarity by defining artificial intelligence - a survey. Philosophy and theory of artificial intelligence. (Muller, V.C., Ed.). Springer.

Murdick, D., J. Dunham, J., Melot, M. 2020. AI Definitions Affect Policymaking. CSET Issue Brief. Center for Security and Emerging Technology.

Myllymäki, A. 2020. Steering ahead through AI. Viewed on 22.09.2021. https://iot.ciorevieweurope.com/cxoinsight/steering-ahead-through-ai-nwid-344.html

Negrotti, M. 2012. (Ed.) Understanding the artificial: on the future shape of artificial intelligence. Springer Science & Business Media.

Nilsson, N.J. 2009. The quest for artificial intelligence: a history of ideas and achievements. Cambridge: Cambridge University Press.

OECD, 2021. The Digital Transformation of SMEs. Viewed on 27.08.2021.

https://www.oecd-ilibrary.org/sites/01a4ae9d-en/index.html?itemId=/content/compo-nent/01a4ae9d-en

Palinkas, L.A., Aarons, G.A., Horwitz, S.M., Chamberlain, P., Hurlburt, M., Landsverk, J. 2011. Mixed method designs in implementation research, Administration and Policy in Mental Health and Mental Health Services Research, vol 38, pp 44–53.

Petticrew, M., H. Roberts, H. 2006. Systematic Review in the Social Sciences: A Practical Guide. First Edition. Blackwell Publishing, Oxford.

PWC, 2021. Artificial Intelligence Revolution – main trends. Viewed on 21.12.2021.

https://www.pwc.com/it/it/publications/assets/docs/pwc-ai-evolution-financial-se-vices.pdf

S. Pourjavan, S. 2019. Definitions: Machine learning, deep learning and AI understanding. Acta Ophthalmologica, vol. 97.

Remi AI, 2019. The value of A.I in an SME, and what does it mean for me? Viewed on 27.08.2021.

The value of A.I in an SME, and what does it mean for me? | by Remi AI | Medium

Saravanan, K., Sreedevi, E., Subhamathi, V. 2017. A Review of Artificial Intelligence Systems. International Journal of Advanced Research in Computer Science, vol. 8, no. 9, pp. 418 – 421.

Sciubba, E. 2009. Artificial Intelligence and Energy Systems: Scope and Definitions. Proceeding of Exergy, Energy System Analysis and Optimization-Volume III: Artificial Intelligence and Expert Systems in Energy Systems Analysis Sustainability Considerations in the Modeling of Energy Systems, vol 3, no 30.

Shanin, S. 2021. How Artificial Intelligence Is Transforming Product Development and Design. Viewed on 25.08.2021.

https://www.eteam.io/blog/ai-and-product-development-design

Steward, B. 2004. Writing a Literature Review. British Journal of Occupational Therapy, vol. 67, no. 11, pp. 495 – 499.

Stewart, J.C., Davis, G.A. 2020. Igoche, AI, IoT, and A IoT: Definitions and Impacts On The Artificial Intelligence Curriculum. Issues in Information Systems, vol 21, no. 4.

Sureka, A. 2020. 7 Practical Benefits of AI for SMEs You Need to Know. Viewed on 20.08.2021.
https://www.clariontech.com/platform-blog/7-practical-benefits-of-ai-for-smes-you-
need-to-know

TechTarget, 2019. Intelligent Agent. Viewed on 23.08.2021.
https://searchenterpriseai.techtarget.com/definition/agent-intelligent-agent

Merilehto, A. 2019. Tekoäly vaatii tekoja – nyt heti. Viewed on 16.09.2021.

https://www.telia.fi/yrityksille/artikkelit/artikkeli/tekoaly-vaatii-tekoja-heti

Telia, 2019. Miten valjastan tekoälyn hyötykäyttöön. Webinar recording. Viewed on 16.09.2021

https://www.telia.fi/yrityksille/onehub/webinaarit-ja-tapahtumat/artikkeli/tekoaly-hy-
otykayttoon

Tietoevry, 2019. Tieto's Nordic AI Survey. Viewed on 20.08.2021.
https://www.tietoevry.com/en/campaigns/2019/tietos-nordic-ai-survey/#Home-67294

Toncheva, I. (2019). How Retailers Use Visual Search to Gain Competitive Advantage. Viewed on
05.09.2021.   https://imagga.com/blog/how-retailers-use-visual-search-for-competitive-ad-
vantage/

Torraco, R.J. 2005. Writing Integrative Literature Reviews: Guidelines and Examples. Human Re-
source Development Review, vol. 4, no. 3, pp. 356-367.

Tranfield, D., Denyer, D., P. Smart P. 2003. Towards a methodology for developing evidence-in-
formed management knowledge by means of systematic review. British Journal of Manage-
ment, vol. 14, no. 3, pp. 207-222.

Turku Science Park Oy, 2019. Varsinais-Suomen Tekoälyverkosto AI Haastattelut 2020 Yhteen-
veto.

Vistage, 2018. Artificial intelligence for small and midsize businesses. Viewed on 20.08.2021.
https://www.vistage.com/wp-content/uploads/2018/09/Artificial-Intelligence.pdf

Voss, P. 2007. Essentials of general intelligence: The direct path to artificial general intelligence.
In Artificial general intelligence (pp. 131-157). Springer, Berlin, Heidelberg.

Wang, P. 1995. On the working definition of intelligence. Technical Report 94, Center for Research on Concepts and Cognition, Indiana University.

Wang, P. 2019. On defining artificial intelligence. Journal of Artificial General Intelligence, vol.10, no 2, pp. 1-37.

Yin, R.K. 2003. Case Study Research: Design and Methods. (2nd ed). New York: Sage Publication