Adoption of articicial intelligence in service organization - the case of Denmark

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Research paper

Abstract

This paper investigates factors affecting adoption of artificial intelligence (AI) in Danish service organizations. Artificial intelligence and robot technologies have been used for decades in manufacturing companies. However, these types of technologies have only recently entered the service sector. Given the exploratory nature of the study, to get an overall picture we conduced eleven expert interviews with representatives from both the public and private service sector involved with AI adoption. The results show that various drivers and barriers affect AI adoption in the service sector. Barriers may be more specific to the sector investigated, while drivers are of more general nature.

Keywords: Artificial intelligence, services, adoption, drivers, barriers

1 Introduction

Artificial Intelligence has gained much ground in the past few years because of advancements in the developments of Machine Learning (ML) algorithms and Natural Language Processing (NLP) and because of the immensely increasing collection and processing of data that Internet facilitates (Huang and Rust, 2018).

According to Danmarks Statistik (2021), in 2019 there were 6% of Danish enterprises with 10 employees or more that used some AI technology, while in 2021, the figure jumped to 24%. In 2021 the EU average of enterprises using some kind of AI technology is 8%, making Denmark the country with the highest use of AI technologies. The three countries closest to Denmark are Portugal (17%), Finland (16%) and the Netherlands (13%), followed by Norway with 11% and Sweden with 10% (Eurostat, 2022).

In this paper, we adopt Kaplan and Haenlein (2019) definition of Artificial Intelligence as 'a system's ability to correctly interpret external data, to learn from such data, and to use those learnings to achieve specific goals and tasks through flexible adaptation' (p. 15). This definition is very appropriate for the current state of AI, even though it is mostly a definition of Machine Learning. Therefore, in this paper, we consider AI not a specific set of technologies, but a label for a broad range of systems that are capable of imitating aspects of human actions that require a degree of human-like intelligence. AI systems are combinations of computing power, software-based algorithms, and the data being inputted and processed. And, such AI systems can be used for many different purposes, which presently are beginning to be developed and used in different industries and other organizations. It is these emerging AI applications that are the focus of this study.

However, even though the percentages from Statistics Denmark and Eurostat for AI adoption at Danish and European level is relatively high, the literature about AI in the service sector is still very limited and empirical studies almost inexistent, expect some studies on chatbots (e.g., Klaus & Zaichkowsky, 2020). Against this background, we are interested in investigating the following research question: How are AI systems used and applied in the Danish service sector and what are the factors affecting adoption of AI systems in such sector?

In order to answer the research question, we draw on theories of adoption and diffusion of innovation (Rogers, 2003; Tornazky and Fleischer, 1990) to conduct an empirical study of AI adoption in the service sector in Denmark. The data collection includes both primary data such as semi-structured interviews and secondary material such as internal reports and participation to conferences and workshops on the topic. The preliminary results show that the adoption of AI in the Danish service sector is still at the beginning and that different barriers and drivers are characterizing the process, some of which are very well known in the AI adoption literature while others are new.

The paper is structured as follows. The next section provides empirical statistical evidence regarding the diffusion of AI in Denmark and at a European level. The following two sections present the theoretical background and methodology, respectively. This is followed by a section presenting the findings. Finally, the last section discusses the results and provides some concluding remarks.

2 AI Statistics

The most recent Eurostat statistics (2022) indicate that Denmark is the EU country with the most widespread adoption of AI-based technology solutions among enterprises (Eurostat Data Explorer). As the collection of statistical data regarding AI use is very new, it is highly likely that the figures are imprecise. For Denmark, for example, only companies with at least 10 employees are included.

Whether this also applies to other countries is not specified. In addition, we need to be cautious with these figures, as there easily could be a degree of over-reporting. However, if the figures from Eurostat are to be taken at face value, a relatively big percentage of Danish enterprises use AI as Table 1 shows.

Number of employees	*Percentage of enterprises using AI*
10 – 49	20
50 – 99	33
100 – 249	45
250+	66

Table 1: Enterprises using AI – by size (Source: Danmarks Statistik)

Not surprisingly, the numbers show that the larger the company, the more widespread the use of AI. The numbers also indirectly indicate that the number of smaller enterprises is far larger than the number of larger enterprises – with an average of 24% of all enterprises with at least 10 employees.

In terms of business sectors, the statistics show that AI is increasingly adopted by service sectors such as Information and communication technologies and business services as the distribution in Table 2 shows.

Sector	*Percentage of enterprises using AI*
Information and communication	55
Business service	30
Industry	27
Trade and transport	20
Building and construction	9

Table 2: Enterprises using AI – by sector (Source: Danmarks Statistik)

Among the AI technologies used by companies, AI for automation of work processes is the most used with 71% of the companies using AI stating that they use this type of technologies. This seems to be a very high figure, however, it is most likely not full automation but automation of parts of work processes. This is followed by Machine Learning with 37% and text analysis technologies with 31%. Please refer to Table 3 for uses of AI technologies in Danish companies.

Technologies based on AI	*Percentage among enterprises using AI*
Analysis of text	34
Conversion of spoken language	16
Production of written text/spoken language	22
Identification based on pictures	17
Machine learning	37

Automation of work processes	71
Autonomous robots	15

Table 3: Use of technologies based on AI (Source: Danmarks Statistik)

Concerning the purposes of using systems based on AI, Table 4 shows that 38% of the companies using AI use AI systems for management purpose, followed by 29% using it for IT security and 27% for Business Process Management.

The numbers reported here are the numbers from Statistics Denmark, which are generally at a very high level of quality and precision, however, given our empirical observations, the numbers seem rather high. We will not in the context of this paper try to understand the possible reasons for the high numbers; instead, we conduct a qualitative empirical study to examine the issue of AI adoption in the service sector in Denmark in order to understand uses as well as the factors driving and hindering adoption.

Purposes of use of software and systems based on AI	*Percentage among companies using AI*
Marketing or sale	23
Production processes	20
Business process management	27
Management	38
Logistics	16
IT security	29
HR	12

Table 4: Purposes of use of software and systems based on AI (Source: Danmarks Statistik)

3 Theoretical Background

The theoretical background of this paper is the adoption and diffusion of technological innovations. The three frameworks most often used for analyses of technology diffusion, adoption and acceptance are the Diffusion of Innovations (DoI) framework by Rogers (2003), the Technology, Organization and Environment (TOE) framework first proposed by Tornatzky and Fleisher (1990), and the Technology Acceptance Model (TAM) first put forward by Davis (1989).

All three frameworks have been applied, elaborated upon and extended in many different ways. Rogers' DoI framework has, however, basically stayed unchanged over time, while the TOE framework, instead, has been tailored to many different settings and the exact content of each of the overall factors - Technology (T), Organization (O) and Environment (E) – has been adapted to the studied context. The TAM framework has also been subject to various developments and extensions, and it is in its substance oriented towards the acceptance of technology solutions at organizational level. In addition, the TAM framework is most often applied in quantitative studies. The DoI framework, although it is entitled 'diffusion', is concerned with diffusion as well as adoption. However, in contrast to the Tech-

nology Acceptance Model, which mostly deal with adoption within organizational settings and at individual level, DoI is concerned with diffusion and adoption at a societal level. The TOE framework, instead, is explicitly concerned with the factors affecting adoption by organizations, and the two frameworks, DoI and TOE, therefore both overlap and complement one another.

The DoI framework is a multi-faceted framework that includes the general understanding of the diffusion of innovation as a "process in which an innovation is communicated thorough certain channels over time among the members of a social system". It comprises the key four components of innovation, communication channels, time, and social system, as well as five characteristics of innovations regarding relative advantage, trialability, observability, compatibility, and complexity, and five stages of innovation process decisions comprising knowledge, persuasion, decision, implementation, and confirmation. Finally, the DoI framework includes five categories of adopters: innovators, early adopters, early majority, late majority, and laggards.

The overlap between the DoI framework and TOE mostly relates to the technology elements. The five characteristics of innovations in the DoI framework are very relevant to consider when analyzing the technology aspects of TOE. Concerning the environmental aspects, the overlaps between DoI and TOE relate to innovations seen as processes of communications, which is the core of the DoI framework.

Since the focus of this paper is on the drivers and barriers for the implementation and adoption of AI in Danish service organizations, both private and public, we mostly draw on central elements from the DoI and TOE frameworks in the data collection and analysis. In this paper, we will, with respect to technologies (the T category in TOE), concentrate mostly on the characteristics of AI technology regarding relative advantage, trialability, observability, compatibility and complexity. With respect to the organization aspect of TOE, we will examine issues regarding awareness, competences and management. Concerning the environment aspect, we will touch upon the general innovation system factors in innovation system theory (Nelson & Nelson, 2002).

4 Research Method

Since our research aims to understand and explain perceived barriers and drivers of AI adoption in service companies, we have chosen a qualitative research design in the interpretative tradition (Miles & Huberman 1994). This interpretive approach to the phenomenon focuses on the qualities of the entities under investigation, the processes, and the meanings occurring naturally in the environment.

The data sources include primary and secondary data. The primary data consisted of 11 semi-structured interviews with experts dealing with AI adoption in 11 different service organizations to get an overview of the studied phenomenon from an expert viewpoint (Bogner et al., 2009) (table 5). According to Bogner, Littig, & Menz (2009), experts are subjects with technical, process and interpretative knowledge in relation to their areas of expertise. Such knowledge is a result of their actions, responsibilities, or obligations within an organization. The experts interviewed in our study are key actors involved directly in AI adoption, therefore related in their real-life settings to the phenomenon under investigation. The selected experts have a high-level overview of the topic and come from different types of service organizations. Given the exploratory type of the research we have included both private and public service organizations in our sample. To identify the experts, we have used press releases, participation in conferences and workshops on the topic as well as snowball sampling (Biernacki & Waldorf 1981). Snowball sampling is a sampling technique for gathering research subjects through the identification of an initial subject who then refers to other actors. These actors may then open possibilities for expanding the sample. Snowball sampling applied especially in the health service field. The expert interviews were conducted in 2021 and were mostly conducted over Teams or

Zoom given the Covid-19 restrictions. They lasted on average one hour each, were video recorded and either transcribed or re-listened several times in the analysis.

Sector	*Number of interviews*	*Position*
Public sector at municipal level	2	Managers in regions dealing with AI
Heath	4	Two health professionals employed in 2 different hospitals (one midwife, one doctor), AI centre leader, administrative manager in a region dealing with health issues
Law	1	Partner in law firm
Education	2	Director of a company providing adaptive learning platforms and an administrative manager at a university
Pension and taxation	2	One manager in a public pension fund and one manager in the public taxation organization

Table 5: Sector and position of interviewees

In addition to the interviews, we collected secondary data in form of media coverage on AI adoption in the investigated units, reports provided by the interviewed or found on the Internet as well as participation in several practitioners and policy conferences and workshops on the topic in the period 2020-2022.

We used thematic coding in analysing the expert interviews. The thematic coding was guided by our research question and the theoretical background. It generally followed the six steps described by Braun and Clarke (2006): familiarize yourself with your data, assign preliminary codes to your data in order to describe the content, search for patterns or themes in your codes across the different interviews and secondary data, review themes, define and name themes and produce your report. The combination and triangulation of the different types of data has contributed both to increase the level of knowledge and to gain an understanding from different perspectives about the phenomenon under investigation (Lewis-Beck et al., 2004).

5 Preliminary Findings

5.1 AI Applications and Use

The analysis of the interviews shows first that, despite the high interest both in the public opinion sphere, public policy and statistical reports (e.g.) claiming high AI adoption rates in in service organi-

zations in Denmark, most of the organizations interviewed are still at the very beginning of the adoption process and struggling to understand application areas and potential benefits. Depending on the size of the organizations interviewed, there are a few or several 'local' AI adoption initiatives in the organizations in questions. These AI systems are like independent islands and usually there is a lack of consolidation of systems within the same organization/department and across organizations/departments.

There is a growing but fragmented interest in AI in the health services in Copenhagen area, and individual hospital units are interested in the link between AI and organization, management, and competencies. Some projects also focus on the interface between the professionals and the citizen /patient.

The technologies in use depend on the sector the organizations belong to. We can distinguish two main types of uses for the AI systems: back office or internal use to the service organization or front end in the communication with the client/citizen/patient. AI technologies for back office either help decision making or improve efficiency by substituting repetitive organizational processes. Examples include RPA for process automation for example in handlings of pensions, to AI systems for imaging diagnosis in hospitals, to AI systems that develop and manage legal contracts in legal services. The AI systems operating at the interface with the customer usually support the communication between the service provider and the client/citizen/patient. However. also such initial communication is often used as a support tool for decision making. For example, the central Danish Emergency Medical System (EMS) is using AI to understand the risk of cardiac arrest of the people calling the emergency number as cardiac arrest is the most time-critical call, which must be answered quickly. Evidence from the project shows that AI can both find more cardiac arrests and faster than they could otherwise. A similar system is also used to understand the risks of pregnant women calling the maternity department to identify the health state of the women calling in. The project aims to find out in real time how the women who call are feeling. As a midwife states:

"It will be a virtual assistant for the midwives. They can be really busy and may have many balls in the air. They must be able to quickly decide how to act."

The pension fund interviewed uses software robots to forecast the topic of calls from citizens to find the right answer or direct them to the right department. In municipalities AI is currently primarily a tool for decision support. However, despite the big expectations from AI, AI is still at a trial and error stage as an expert states:

"Management often has a belief that AI can be a "magic wand", but it is now mostly "broken illusions" that are the experience at the moment."

5.2 AI Drivers

The findings point out a number of drivers of AI adoption in the service organizations interviewed. Some of the drivers are sector specific while others go across different types of service sectors. For example, in the medical sector an important driver of AI adoption is an improvement in the virtual communication with the patient as AI may help identify the level of health risk of the person calling the emergency system in order to improve the quality of the service provided to the patient. Another driver is that AI technologies may also contribute to better use the available resources and act as a society equalizer. As a respondent says:

"Chat boxes can sort women who call in so that the most acute come before those who call first. We have population groups who speak poor Danish. They have a harder time at that (telephone) meeting. AI will be able to help with this - inequality in society."

In addition, a driver is that AI has the potential to improve the treatment quality for example through image diagnosis in hospitals. In addition, development of predictive models could be used to reduce

the problems of "no-shows" based on data analyses of personal data of patients and their previous behaviour.

Municipalities do not primarily adopt AI to save money, but to create better case management and better service quality for citizens. Estimates are what the public employees usually do. It will not be different with AI, but AI can provide a better basis for case judgment.

In back office, increased employee satisfaction is also an important driver. By using AI in repetitive, tedious tasks, employees may be more satisfied because they do not have to take care of them but can focus on the most interesting tasks. In addition, AI may contribute to increase efficiency and do more with the same number of employees. For example, a respondent employed in the taxation office stated that:

"Product flow will increase by a factor 10 within 5 years and we will have as many customs' officers as now"

In the personal services such as legal and private education services, important drivers of AI are improved efficiency through document handling and contract writing.

5.3 AI Barriers

There are no organizational strategies for AI in the organizations interviewed nor specific Human Resource initiatives to broadly recruit AI specialists. There is mostly a bottom-up approach to the adoption of AI, where either top management does not formulate any AI vision at all or, if they formulate overall visions, they leave it to the individual units to be responsible for AI development and adoption. Such AI initiatives are mostly initiated by "innovation champions". These initiatives are usually driven by key knowledgeable employees. On the other hand, middle and top management usually support the AI projects when initiated by a champion in the organization. The customers or citizens do not demand AI solutions.

In addition, top management's intentions and understanding are not always precise, which creates problems with AI expectations alignment between top management and managers responsible for AI implementation. Finally, management readiness to rely on data as well as lack of awareness in the organization of what data can do is an important barrier. For example, the respondent from the pension fund states that management is very careful about implementing new technologies. They do not test new technologies, but adopt technologies that are already well tested and

"Prefer to start with small pilot projects, that are closed down if they do not function well as "changes must take place slowly".

Finally, management lacks knowledge of what to do with AI and management's attitude towards AI is a bit conservative as, in general, top management knows the business side very well (especially those who have been there a long time), but does not know much about technology, especially AI. In one hospital, there is also a lack of vision at organizational level and lack of strategy about data and lack of understanding of data at different levels. However, the experts state that the lack of AI competencies in their organization as well as lack of AI awareness is also an important barrier at employee level. For example, a respondent in the healthcare sector states that the midwives have been quite sceptical concerning AI technology. Employees are afraid of losing their jobs. They think that AI will replace them. However, she does not believe in full automation.

"It's a lot about an interpersonal contact…It is fundamental for another human being able to communicate it - even if the decisions are made by AI. But there must be someone who is responsible and convey it".

Another important organizational barrier is the IT-legacy competence of key employees that know the IT systems and the data stored in them very well, but do not have proper understanding of AI potential. As a key employee at a public organization states:

"In other words, it is not data scientists or STEM that is the central competence barrier internally. Hard STEM competencies are bought in the consulting market. "Understanding the market" is therefore a key ordering competence."

In addition, there is employee resistance to AI systems in the organizations not because they have something decidedly against AI, but because IT systems often become a burden in the daily work life.

Another important issue is the legal one: Who is responsible? For example, according to a respondent in the health sector everyone can make mistakes because they often make a tentative diagnosis:

"*So, is it the algorithm that is responsible or the healthcare professional? Some have also asked: What does it do to my competencies? Am I getting worse at diagnosing?"*

The experts interviewed face GDPR problems and need several permissions to access and handle data. Data quantity, quality and link between data located in different organizational departments are barriers highlighted especially in the health and legal sector. That is a problem for rapid AI adoption. GDPR has made AI solutions to be adopted at local level, as there is a big number of GDPR issues in interlinking data belonging to different department or units. For example, in one hospital centres and clinics are spread over 8 silos and this is of crucial importance for AI adoption and implementation. However, they are working to solve the GDPR issues and try to develop AI solutions that fit with GDPR legislation.

Patients are willing to share their data to help people who are sick. However, they find that the algorithms are increasingly being used for control and this hampers patients' willingness to provide information.

The municipalities are getting the AI systems up and running in the organizations, however adoption of such systems at organizational level is the real problem and not so much the technology. However, a respondent states that even though the AI systems are well developed from a technical point of view, it is far from always that they live up to expectations:

"The suppliers are currently pure Wild West which promises everything and delivers far too little value"

Concerning recruitment of employees with AI competences, the findings show that it is relatively easy for the organizations located in big cities or in their close surroundings (Copenhagen and Aarhus) or with an interesting IT architecture, while it is relatively more difficult for organizations located outside big cities. Public organizations have a bit more difficulties as they cannot compete with private organizations salary wise. For example, a respondent in a pension fund finds it difficult to attract the good candidates both due to location (part of big Copenhagen area), but away from Copenhagen and the fact that they cannot offer the highest salary being a public organization. Finally, the lack of organizational visions and strategy can be a barrier to recruitment if AI employees feel that need to be innovation champions as a respondent states:

"Our organization does not attract the best AI data competencies because it requires that you are an innovation champion to be able to work here".

The expert in the legal sector states that there are many barriers due to the nature of business as various documents cannot be standardized. In addition, even though some legal companies are starting to adopt AI, they are very conservative and regulation in the field is a big barrier. They also experience that there is a lack of competition pressure and lack of demand from clients as well as a lack of necessary critical mass of documents, but he believes that

"When the "code is cracked" then we might see a lot of disruption in the sector".

6 Discussion and Conclusions

The study shows that the statistical data about use of AI in companies with more than 10 employees is relatively high with 24% of the companies surveyed responding that they have some form of AI system. The larger are the surveyed companies in size the more likely it is that they have adopted some kind of AI systems. In addition, Denmark Statistik (2021) shows that the Information and Communication Sector and Business Services sector are the ones that are mostly using AI and that management, IT security and business process management are the most common purposes for using AI. Finally, process automation, machine learning and text production are the most important uses of AI. These figures, however, do not completely reflect the results of our qualitative investigation, which show that adoption of AI is still very limited both in the organizations where the experts interviewed are employed as well as in the whole sector the organizations belong to. Our qualitative study supports the statistical data that AI is mostly used as a management support tool such as in the case of image diagnosis in health care or for text production as in legal services. In addition, our study identifies a number of drivers and barriers of AI adoption that hamper such a process in service organizations in Denmark. Important barriers include lack of awareness, conservatism, regulation, lack of competition pressure, lack of demand from clients, lack of necessary critical mass of documents, nature of business, data quality, data security, lack of IT and AI competencies. Important drivers include virtual communication, better decision making, social equalizer, better case management and better service quality.

To conclude, this study provides some preliminary findings about factors driving and hindering adoption of AI in the Danish sector in Denmark as well as it sheds light about AI use. However, given the limited number of interviews, further studies conducting a bigger number of expert interviews in each of the service sector identified is recommended for future research. In addition, future research could conduct in depth case studies of AI adoption employing for example ethnographic method to understand micro-practices of AI adoption in the service sector.

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