Job criteria for successful use of AI

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ABSTRACT:

Purpose: *The purpose of this research is to find criteria for jobs in order for AI to be used. These criteria show why some jobs can use AI, and why some other cannot.* ***Design:*** *This was researched through a literature review of 20 jobs in which AI-possibilities are already widespread. This was supported by semi-structured interviews with people already working with AI.* ***Findings:*** *The three main criteria for jobs found were 1. Having one or more tasks that are routinely and repetitive, and do not require creativity. 2. Having enough data to train the AI. 3. No empathy or caregiving needed for the task. Next to this, it was found that the impact for lower-income jobs is higher and that the future way of working will change drastically.* ***Research limitations:*** *Limitations to this research come from the small number of interviews.* ***Theoretical implications:*** *This research builds on the theory of job design by constructing criteria for AI use in jobs. Next to this, it also finds that low skill variety, task significance/identity and low autonomous jobs are at risk of becoming obsolete.* ***Research practical implications:*** *The findings of this research can be used in determining if any job can use AI now or in the future. Implications also are that employees need to realize the change that is coming and prepare for it.* ***Originality value:*** *The originality of this research can be found in the focus on multiple jobs at once, looking at the broad use of AI. And in the research of AI within job design theory.*

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1. INTRODUCTION

Artificial intelligence is one of the fastest evolving technologies applicable almost everywhere, from everyday life to working environments. Artificial intelligence (or from now on AI) can be defined as synthetic intelligence or computer system intelligence that simulates intellectual functions (Shaffer, Gaumer, & Bradley, 2019). AI is one of the most booming technologies right now. With the increases in computing power, advances in machine learning algorithms, dramatic increases in data volumes, and new data structures to manage the volume AI is providing more possibilities in different work sectors. AI has driven improvements in for example operational efficiency, asset utilization and medical diagnoses. AI use is becoming more popular and its impact is only beginning to be realized (Euchner, 2019).

Considering AI's effectiveness, it is inevitable that AI will take over some specific roles and tasks currently performed by people within the working environment, as machines can take on more and more human work. But even though AI can improve work effectiveness a lot, not every job seems ready to use AI, whilst others are already doing so successfully. Even though the amount of companies using AI is growing steadily, the actual application of these technologies is yet to be done by many, in the US, EU and China only 34% of businesses, have deployed AI (Press, 2020). Research into these jobs that are already supported by AI could point out the reasons why they already are, and why others are not. If AI improves effectiveness for a lot of jobs, criteria for successful usage must exist, otherwise all jobs would use AI.

The knowledge gap this research aims to close is therefore if there are certain criteria jobs need to have in order for them to be able to use AI. The current discourse in research regarding AI is largely positive and research into different AI applications is booming. A study by MIT technology reviewed the heading of AI research, they found around a 1000 papers written in 2015 about AI. From 2018 they already found around 4000 papers regarding AI (Hao, 2019). This increase of 400% only shows the increase in interest in this topic. However, research in the differences in jobs in AI use seems scarce.

For example, in healthcare, a lot of the research for AI use in that sector is about operating and diagnostics tools, so the applications for medical professionals. Other professions in that area, like nurses, are less to not mentioned. This leads to think that there are there certain criteria for a job to be supported by AI. This seems to be the case since otherwise it would be logical that many more would have already applied it, because of its positive effects on effectiveness. However, in the current research regarding AI for jobs this is almost not mentioned, leading to think that there is a gap in the knowledge. The objective therefore was to find out why it is that these jobs can be supported by AI.

This gap in the knowledge about the use of AI lead to the following research question.

<u>What are the criteria for jobs to be supported by Artificial Intelligence?</u>

To come up with these job-criteria we will use job design theory, which tells us that there are five core job characteristics (Kulik, Oldham, & Hackman, 1987):

1. skill variety: If the job require a variety of different activities in carrying out the work.
2. task identity: If the job requires completion of a whole, identifiable piece of work.
3. task significance: How much impact your job/work has on others.
4. autonomy: How much freedom and independence you have in your work and choosing how to do it.
5. job feedback: The amount of feedback in your job you get about your performance.

These are the main parts of job design, which more simply said translates to what kind of tasks and responsibilities you have. Another important part of job design is also the (financial) rewards you get. And this is where we were looking for the job-criteria, we were looking for criteria in the design of a job in order for the job to be supported by AI. For example, what kind of tasks does a job need to have, does the job need to have a high or low skill variety etc.

The relevance of this research comes from its aims to close the knowledge gap mentioned before. With the huge amount of attention AI has been getting, the amount of research in this subject has been a lot in the last years. However, research seems to be a lot about a specific use of AI, the future applications of AI or the challenges of AI. Research looking at the jobs that are using AI and why it is that they can use it and indicating then why it is so that other jobs cannot use AI is a useful complementation to the knowledge pool regarding AI use.

Other, more practical relevance of this research comes from an analysis of jobs supported by AI and jobs not, and the resulting criteria for jobs that are being successfully supported by AI. Companies can use these criteria if they are looking to use AI, to see which jobs are ready for AI to be used in successfully. For companies that have already started using some AI it could be relevant to see how they could further use AI and how other professions seem to do so. Employees are able to use this research as well, to see if their jobs are safe from AI application or if they stand to expect it in the future.

In order to not have to research every job there is on the planet, some pre-research has been done regarding areas in which AI has already seen a lot of use. Looking at the literature, AI development and use can be found in a lot of domains. However, a 2019 study by Dwivedi et al. looked at opportunities and challenges for areas in which AI could be applied. And they identified the following fields: Digital Imaging, Education, Government, Healthcare, Manufacturing, Robotics and Supply Chain (Dwivedi, 2019). (Digital imaging is mainly used in the healthcare industry and can therefore be found under healthcare.)

Further study of the literature led to the inclusion of other domains as well, in which AI use was also quite advanced. These were marketing, transportation, employee management, finance and agriculture (Clark, 2020; Bloch, 2019; Getsmarter, 2019). After this analysis of the most important work-domains using AI already, this study will focus on jobs in the seven domains below, which are deemed most advanced in AI use. These are jobs in healthcare, employee management, transportation, marketing, finance, manufacturing, and education

In an aim to be an all-inclusive study into the use of AI in jobs, the domains that were less often featured in the literature and with less current applications for AI, will be shortly elaborated upon after the first seven. These are agriculture, retail, robotics, supply chain and government.

2. METHODOLOGY

This qualitative research consisted of a literature review and semi-structured interviews. Qualitative research is research into understanding certain phenomena using methods that use word, instead of numbers, as data for analysis. It does not aim to measure something resulting in for example a percentage like quantitative research does, rather qualitative research aims to understand something through for example interviews or a

literature review (Bricki & Green, 2007). In this way, the literature review gave information on AI supported jobs. The interviews have given practical information by managers that have already worked with AI. This combination of practical and literature information has led to the best opportunities to come to an all-inclusive answer.

A literature review can be defined as an analysis, critical evaluation and synthesis of existing knowledge relevant to your research problem (Hart, 2018). With the literature review current AI usages in jobs were analyzed. Analyzing per domain, jobs that have the opportunities for AI use, and what exactly the AI is used for. These jobs were analyzed on the basis of job design theory, to look for criteria. The literature review was performed through Google, where potential articles were searched for. The literature chosen was mainly practitioner literature and some scientific literature. Scientific literature was mainly based on opportunities and challenges of AI, not on its practical use. That is why practitioner literature was used mostly as it did focus on practical use, and Google because it was the best way in finding this practitioner literature.

Inclusion criteria for the literature were:

1. Not from before 2015, as with the speed of development within AI older literature will be outdated.
2. Include the words AI or artificial intelligence and one of the domains (e.g. healthcare etc.).
3. Literature must contain references to another research or reliable source, to make sure practitioner literature is fact-based.

To also gain information closer to the source, personal semi-structured interviews with managers, researchers or employees that are already using AI in their job or company have been conducted. Interviews were needed because, as said before, there was not a lot of literature considering why AI can be used for certain jobs. The interviews gave conclusive information that, together with the information from the literature review, has been used to answer the research question. A semi-structured interview can be defined as a meeting, in this case online or by phone, in which the interviewer does not strictly follow a formal list of questions. A prepared list of questions is brought, but not all questions have to be asked. Questions were mainly open-ended questions, allowing for discussion to take place (Doyle(B), 2019). With the current Covid-19 crisis doing these interviews in person would have been difficult, therefore these were conducted online or by phone.

Criteria for interviewees included:

1. Having worked with AI for at least a month, to have gained knowledge about AI.
2. Interviewees must have a good level of knowledge of AI.

If the interviewees agreed upon recording the interview, the interviews were transcribed. The questions that were asked ranged from their experience ranged from their experience of the AI use within their company, to which jobs they have that are being supported by AI and which not, and their ideas on why that is. The data coming from these interviews has been collected, reviewed, and analyzed for patterns in the data for AI to successfully support jobs. This analysis has been done by the use of coding. Coding can be seen as a fundamental analytic process, in which similar insights are grouped under the same conceptual labels (Corbin & Strauss, 1990).

The data used in this research resulted from four interviews. The interviewees will remain anonymous throughout the rest of the research and will only be referred to as employee 1, 2, 3 or 4. Three of these interviews were conducted with HR employees (employees 2,3,4), of a large Dutch bank that all had been involved with the usage of AI within their organization. These interviews were conducted in Dutch. The other interview was conducted with a researcher/radiologist of a large Dutch hospital (employee 1), who had been working with AI and researching its possible appliances in the hospital. This interview was conducted in English. The transcriptions of these interviews have been referred back to the interviewees for verification. All have agreed with the transcriptions or abstained of reaction to this question, for whom after a couple of weeks agreement has been assumed.

For privacy reasons, the 38 pages of transcribed interviews will not be added as an appendix. However, seven of the questions have been added as appendix A, to give an idea of the type of questions that were asked.

The interviews were analyzed, and similar insights, quotes and examples were coded under the following categories:

- Reasons to apply AI
- Reactions from employees to AI application
- Criteria for work being able to be replaced by AI
- Criteria for work not able to be replaced by AI
- Examples of AI appliances
- Employees adapting to AI
- Future of work with AI

From these categories, quotes and insights will be used as further explanations and insights to the research question and goal.

3. RESULTS

3.1 Literature review

This chapter will give information about the current use and possible applications of AI in the working environment. This section will discover jobs having used AI per work-domain and further analyze how they use AI. These work domains have been chosen based on previous literature that identified the areas in which AI was most advanced, in order to discover AI supported jobs.

3.1.1 Healthcare

AI is being heavily adopted in hospitals. Increased efficiency by the usage of AI in diagnosis, treatment and monitoring of patients sees medical professionals being enthusiastic towards AI. Mundane tasks can be automated with more speed and better accuracy leaving medical professionals more time for more complicated tasks (Dwivedi, 2019).

The main professions in healthcare currently using AI are medical professionals, these jobs score high on all job design characteristics as these jobs are very important, autonomous and require many skills. Also, medical professionals gain high financial rewards for being very specialistic and responsible jobs. Pathologists can see many advantages of AI implantation, as for example in the diagnosis of diseases and illnesses, AI can be used. A study by the university of John Hopkins in the United states showed that some 10% of all US deaths in 2015 were caused by misdiagnosing of illness or medical error (Daniel, 2016; Daley, 2019). Different AI applications exist that can help in diagnosing and even treating illness, in a more effective way with less chance of error (Daley, 2019). Radiologists, who use medical images like x-rays or CT-scans to diagnose illness or injury, are also profiting from AI. As 90% of all healthcare data comes from medical imaging (Doyle(A), 2019), radiologist can only seem to profit from improving the reliability and speed of use of the data. AI software can analyze and screen digital images more efficiently than humans. For example, a recent Chinese study in Beijing compared the diagnostic precision of AI software with that of Chinese teams of specialist doctors. The AI

software had an accuracy of 87 % in diagnosing brain tumors, whilst taking 15 minutes. The doctors could only diagnose 67 % and needed double the time to do so (Gillespie, 2019).

Robotic surgeries are on the rise as well, where in general surgery will not be taken over by robots as it still requires a human hand Surgeons can be assisted by AI powered robots in performing less invasive and more precise surgeries. A company called *Mayo clinic surgeons* in the US already offers robotic surgeries, including cardiovascular surgery and spine surgery (Doyle(A), 2019). This company has robots aiding surgeons in performing surgeries in a more precise way and with less chance of error. The role of AI is that it can help in optimizing these procedures by analyzing medical records of a patient before the operation and guiding a surgeons instrument during the surgery (Marr B, 2019). An example video of *Mayo clinic* shows a surgeon performing a partial knee replacement whilst watching the knee projected on a screen, showing him exactly where to operate. Next to that the robotic arm also keeps him from moving outside of the targeted area, preventing him from making any mistakes (Mayo clinic, 2020).

3.1.2 Employee management

Employee management is a broad area, it entails everything with ensuring employees do the best for the organization and have the best fit with the organization. In this area, AI has multiple applications for different jobs.

First, Recruiters have already been able to use AI a lot. In the recruitment process, AI can be used in the screening of possible job applicants, with a virtual recruitment bot. The bot screens through all the applications for a certain position and uses this data to select the candidates that are best suited for the job. This shortened screening time per applicant from 32 to 8 minutes (Krumina, 2019). However, after screening many other tasks still need to be performed by the recruiter, therefore having a high skill variety.

Another AI influenced job is the line manager. Line managers can be defined as the people within an organization who manage their subordinates every day, making sure that everyone does their job correctly and efficiently (Nehles et al, 2006), this makes it a job with a high skill variety, autonomous and task significant. In running a successful company, line managers rely on successful employee engagement, in which AI can aid with. An AI software called “Sentiment analysis” is a technique that uses algorithms to analyze the behavior, conversations, and overall activity of employees in a team and monitors and understands the mood and satisfaction of employees in the workplace (Krumina, 2019). This information can then be used by line managers to help employees where needed. But for managers a lot of potential for AI can also be found in augmented working. This is the idea that AI machines will help humans do their jobs more efficiently, as they will take over some mundane aspects of our role, leaving us free to do tasks which are better suited for humans as they require creativity and interhuman interaction. (Marr A, 2019) An example of this is AI taking over administrative tasks in jobs. Tools already exist that will learn how to carry out repetitive tasks, such as arranging meetings or managing a diary. By using these tools managers can free up time, otherwise lost on administrative tasks, for other more important aspects of their jobs.

Whilst these tools can mostly bring positive implications for many managers, administrative workers could be the ones suffering the most as their jobs would become obsolete if taken over by AI. Their jobs score low on skill variety and task significance, as their job consists of a lot of data processing, something which AI software is very good at.

3.1.3 Transportation

The market for autonomous cars and other autonomous vehicles is seeing a huge grow, with the full market for AI in transportation to already reach 3.5 billion dollars by 2023 (Joshi, 2019). Even though many people are still skeptical of the safety of these vehicles, they are no longer only a thing of the future as autonomous taxis are already driving around Tokyo (Joshi, 2019). Even though these taxis still require a driver to be present, Taxi/ride services drivers can expect the demand for their jobs already reduce drastically over the coming decade (Krasadakis, 2018), as true autonomous cars are becoming more sophisticated and therefore more probable by the day.

Companies like Honda, Toyota, Tesla and others are already aiming for the end of 2020 to have their first cars be able to drive autonomously on highways (Faggella, 2020). However, these cars still require a driver to be present in case of emergencies, as they do not have yet the technological ability to be fully autonomous. Also, the true adaption of these vehicles depends on the regulatory developments in the coming years. Companies will not develop true self-driving vehicles if it is not allowed to drive anywhere or if their legal liability would be immense (Faggella, 2020). Still, considering many companies still invest heavily in autonomous vehicles the implications for transportation professions will be large.

Next to people transport, product transport could benefit heavily from autonomous trucks. Maintenance and administration expenses are expected to decrease by about 45% (Joshi, 2019). Truckers can see their jobs at risk in the upcoming years when these autonomous trucks become sophisticated enough.

Autonomous vehicles can have a future impact on delivery drivers as well. Be it through flying autonomous drones or autonomous delivery vehicles, drivers are bound to be impacted as these services will take over their jobs (or parts of it) in the future. Autonomous delivery is not used much right now, but a 2016 study by McKinsey & Co. predicted that 80% of global deliveries will be automated in the upcoming decade (Ochwat, 2019).

The jobs in this domain are all quite similar as you could generalize them to Professional drivers. These jobs have a low skill variety, the main task being driving from one point to another. Low autonomy as they do not decide where or with what they are driving. But they do score high on significance, feedback and identity, as they do impact a lot of other people with their performance. On which they also get a lot of feedback from customers or managers.

3.1.4 Marketing/customer relations

The world of digital marketing is already using many AI-powered tools to gain information and recommendations regarding ad placement, consumer behavior predictions and better content creations for customers (Getsmarter, 2019). The effect of AI has changed the role of marketeers heavily, the role of physical media is diminishing whilst online media is booming. Marketeers rely a lot on AI information these days , as AI provides insights into targeting the right and most valuable customers, effectively increasing the result of sales (Clark, 2020). These days, AI can even create small pieces of text, making the narrative so that it seems like it was written by a human. In this way AI can create small marketing messages, specifically targeting groups but also profit and loss summaries or sports game recaps (Karlson, 2017). But creativity in coming up with new marketing ideas is still an important part for marketeers, therefore they do have a high skill variety. As they need to come up with ideas, design or plan it etc.

AI chatbots is another phenomenon influencing marketing in the last couple of years, as these bots are becoming more sophisticated each year. These bots cannot only help customers during the sales process by answering questions, but they can also be used earlier in the marketing process by researching customer preferences through chat and providing detailed suggestions for products (Karlson, 2017).

A job that is however bound to suffer from these AI chatbots is the one of customer service reps. As AI is becoming better and better in helping customers, the number of humans working in call centers or online chats is bound to decrease. Whilst not all these jobs will become obsolete, because some cases will still be too complex for AI, easier conversations like providing information on delivery time or return policy, can be handled by the AI chatbots. This job is another prime example of a low skill variety job experiencing heavy effects of AI application, and in which therefore humans are at risk of becoming obsolete.

3.1.5 Finance

The finance sector has been one of the first adaptors of AI technologies. As the world of finance has moved almost completely to the online environment, AI software has many possible applications for a couple of important jobs (Azulay, 2019).

For traders, AI has proven to be something that, if used correctly, can provide a great advantage over their competitors. AI has the ability to crunch a vast amount of market data quicker than any human can and use this data to provide information about the stock market. Traders use this information to make well-informed decisions regarding what to invest in, and when to buy and sell stocks (Getsmarter, 2019). AI can do this through the same technique used by line managers called sentiment analysis, by analyzing the sentiment of consumers regarding certain companies and stocks, to assess whether this sentiment is positive or negative (Azulay, 2019). Next to this, AI can also analyze past data streams and observe patterns in this data. When the AI notices a pattern recurring, it can forecast stock market reaction based on the past data analysis (Getsmarter, 2019).

Another job impacted by AI is the one of a banker. A banker is quite a broad description, but their tasks range from credit analysis to assisting clients and authorizing loans. Banks require extensive analysis of potential customers, be it individuals or companies, before lending out money. AI is used in assessing someone's trustworthiness through an analysis of online behavior and past credit history (Azulay, 2019). AI software can do this quicker and more extensive, leaving the banker more informed and with more time to make decisions.

For accountants, the introduction of AI into their field has led to them having more time spend on advisory services. Many basic accounting functions require the collection and processing of data, for example in auditing or in risk assessment. These functions have all been automated, leaving accountants more time to analyze and interpret these results effectively helping clients at a higher level (Shaffer, Gaumer, & Bradley, 2019). Consulting services will become the main concern for accountants, as AI can crunch and process the data but cannot give solid advice yet regarding this data. Therefore, the jobs of accountants are not at risk of becoming unnecessary (Rana, 2018).

All of these jobs do have parts of their job that have a low skill variety, task identity/significance, but how they differ from jobs like the customer service rep is that next to those tasks they also have other tasks that do require other skills and that are more important. That is why AI can not take over these entire jobs, as some tasks are still too complex for AI.

3.1.6 Manufacturing

In recent decades automation has steadily replaced humans at assembly-line jobs, as robots can increasingly perform better in limited and repetitive functions. For example, a robot can nowadays sort big apples from small oranges more efficiently than any human (Gillespie, 2019). For assembly line workers this means that their jobs will become supported by robots or completely taken over, as again their jobs have a low skill variety and task identity/significance. A further step in the improving the manufacturing process is supporting these robots with AI. Whilst these robots already improve efficiency over that of a human workforce by being able to work 24 hours a day, AI robots can also provide real-time data of their operations at the same time. And that is what makes these AI robots different from regular automated robots, that besides improving productivity they can also use the data they generate whilst working to predict when maintenance might be needed, reducing the chance of downtime of production (KNOWARTH Technologies, 2019).

The data that AI provides regarding its operations can be used by engineers/designers in improving these AI robots even further. AI software can analyze the production process and recommend areas in the process where improvements can be made. Quality assurance can also be done by AI, alerting engineers whenever problems in the quality of the product or the process is detected. Before the actual production, engineers use AI algorithms in the design phase through generative design, in which engineers can test out possible configurations of systems. Through a method of trial and error the best solution can be found by testing systems out with the AI and improving upon the results (KNOWARTH Technologies, 2019). Because this job requires coming up with new solutions and ideas, skill variety and significance is way higher than that of the assembly line worker.

3.1.7 Education

The use of AI within education will lead to an improved effectiveness of teachers and higher student engagement (Dwivedi, 2019). A study by IDC ,a market research company, showed that of 509 higher education institutions in the USA, 99,4% of all respondents believed that AI would be crucial to their institutions competitiveness within the coming three years (Ayoub, 2020). For teachers AI assistance has a range of options and is bound to change their jobs. However, being a job that scores high on all characteristics, this change will limit itself to helping teachers and not replacing them. One possible use is the one of chatbots aiding students. A university professor in Australia has already build a question bot, which can answer questions of students on its own, or if of a too high level can mark the questions for teaching assistants to answer (Ayoub, 2020).

However, the currently most used form of AI in education lies within learning analytics. This is AI software analyzing the current level of understanding of students on certain topics, by having students answer questions about the material, and using this to build personalized curricula for each student (Kulkarni, 2019). This personalized curricula then aims to fill any knowledge gaps that the software has found within the students understanding. Leaving teachers more time to spend with students and focus on perhaps more complex matters. Students can also practice their (foreign) language speaking, as speech-recognizing algorithms can help students to improve their vocabulary and pronunciation from their home. However, improving conversation and writing skills are still in need of human interaction as that requires a certain level of creativity that AI cannot yet imitate (Kulkarni, 2019). The final application is probably the most controversial one. Collective intelligence tools exist that are able to grade papers and essays (Ayoub, 2020). These algorithms use large collections of human-graded essays,

and try to identify patterns within the text that correlate with lower or higher grades (Kulkarni, 2019). However, usage does not seem very close as these algorithms are very controversial as they seem easily fooled into giving higher grades by simply using more sophisticated words and having a longer essay length.

3.1.8 Other

For the domain of **government**, most AI supported jobs can be traced back to other domains. A 2020 study looked at the use of AI for governance (Sharma, Yadav, & Chopra, 2020). It found that most applications could be accounted to other public domains, like healthcare, education or to some degree finance. The job that can only be accounted to government is the one of policy maker/politician, who can use AI driven data and context in order to make better informed decisions (Sharma, Yadav, & Chopra, 2020). But this job has many other aspects, making it score high on all characteristics.

For **agriculture**, the job that uses AI is the one of the farmer, this domain is not very important for this research as within agriculture the main, and possibly only, job is that of the farmer. However, the possible AI usages for farmers are many. AI software can use data from the farm to help the farmer make better informed decisions regarding for example when to harvest/irrigate/apply toxins (to) crops. Other usages can be found in drones being used to monitor the fields and agriculture robots being used to harvest crops faster than any human can (Walch, 2019). Being a very independent and diverse job, the farmer does score high on all of the characteristics of job design theory.

Retail can be found in a combination of different other domains like marketing, finance and transportation, for the production, shipping of retail products. Physical selling jobs still rely much on human contact and are therefore not very applicable for AI. A retail job that would suffer from AI is the one of customer service rep which was already named in the marketing part. This is of course as AI chatbots can be used to answer questions, whether it being online or through screens in physical stores.

The field of **robotics** is a bit of an odd one out as it deals with the development of AI. Of course, software engineers use AI, but they use it in a similar way as designers/engineers do as noted in the manufacturing part. They too can use generative design in testing their software's using AI algorithms. Robotics is a bit of an obvious one that can use AI, as it develops AI, and is therefore not very relevant to this study which wants to look at jobs for which it is less obvious why and how they can apply AI.

Supply chain is a very important area, but it basically exists of the two before mentioned areas manufacturing and transportation as it deals with producing and distributing products. Therefore, only the supply chain manager/planner is the job that can be identified in this domain that is starting to use AI. An AI software can collect data from the entire supply chain and analyze patterns in this data which can be send back to managers as information. These managers can use these insights, predictions and recommendations to improve supply chain performance (McKendrick, 2020). Like the policy maker, this job consists of many more tasks than what AI is used for, it being a high skill variety and task significant/identity job.

With this literature review, twenty jobs have been discovered and analyzed that are influenced by AI. When using the job design theory by Hackman and Oldham, hard criteria for why AI can be applied/used in certain jobs cannot be constructed. All jobs are very different, also in the levels of the job design characteristics. However, all are perfectly able to use AI in their jobs, indicating that we cannot make criteria purely based on this theory.

However, one thing was noticed. This is that the main difference between the jobs is, that some are at the risk of being replaced by AI automation and some only stand to gain from the use of AI and become AI augmented jobs. We can explain this via job design theory, as this difference between AI replaceable and AI augmentable jobs mainly comes from the fact that AI replaceable jobs have a lower skill variety, task significance/identity and autonomy. Their work is more repetitive and consists of a couple simpler tasks in which AI can be used to increase efficiency. These jobs are simply said less difficult and therefore less important to the organization, these are therefore also the jobs with less pay. AI augmentable jobs have many more different tasks requiring a lot more different skills and creativity, therefore scoring higher on the characteristics. AI use in low skill variety jobs is likely to be far more disruptive for the employees, who are at risk of becoming obsolete. Only job feedback cannot be as easily appointed to a sort of jobs, as those levels differ throughout all of them. Figure 1 gives an overview of the jobs listed in the literature review.

Figure 1: Overview of analyzed jobs

AI replaceable jobs	AI augmentable jobs
Administrative workers	Supply chain manager
Taxi/ride service driver	Policy maker
Delivery driver	Farmer
Assembly line worker	Engineer/designer
Truckers	Accountant
Customer service reps	Banker
	Trader
	Line manager
	Recruiter
	Marketeer
	Teacher
	Pathologist
	Radiologist
	Surgeon

3.2 Criteria for AI to be applicable

Where job design theory did not directly lead to hard criteria for AI to be applicable in jobs, criteria can be found from the simpler version of job design, simply being what kind of tasks and responsibilities a job has. After the analysis of the tasks in the 20 jobs from the literature review and comparing this to the views of managers using AI found in the interviews, we can say that to all of the jobs some criteria, for what kind of tasks a job must have, are applicable or have been applicable in order to have successfully adopted some form of AI. These are:

1. Having one or more tasks that are routinely, repetitive and do not require creativity.
2. Having enough data to train the AI.
3. No empathy or caregiving needed for the AI-intended tasks.

Figure 2: Decision tree for the usability of AI

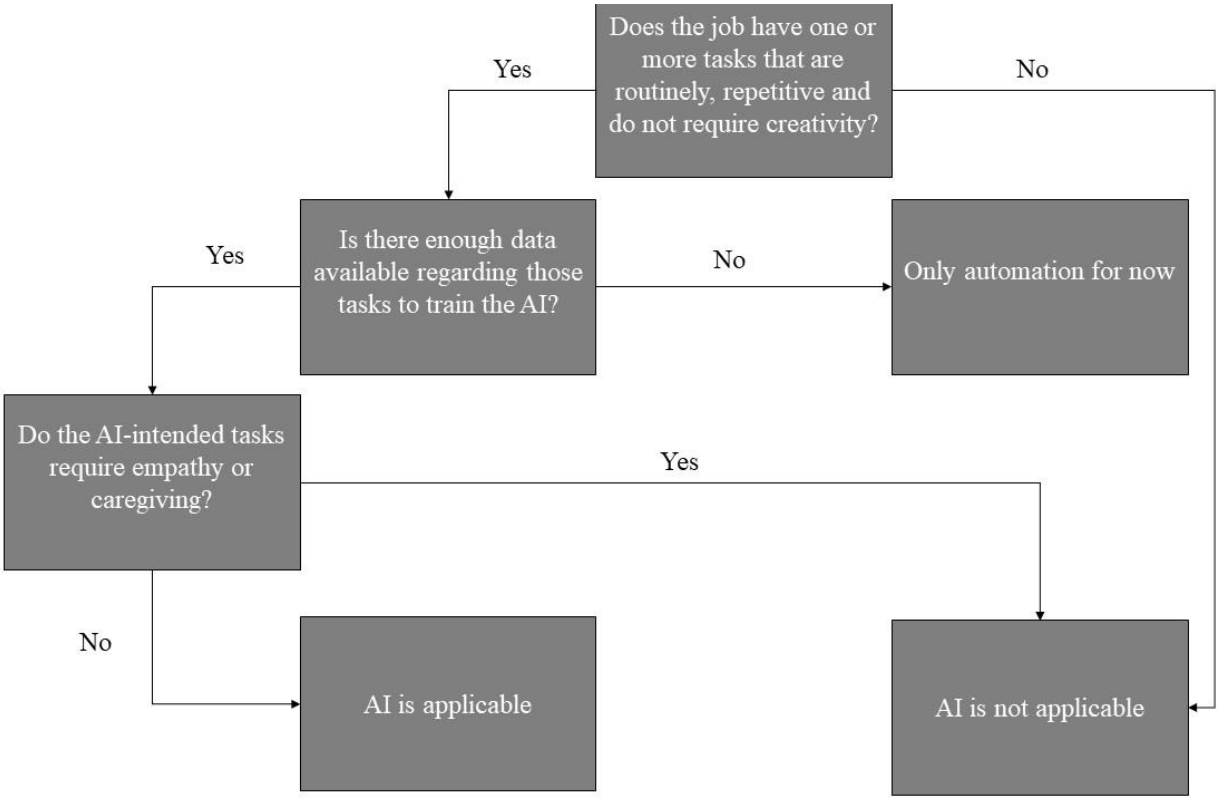


Figure 2 shows a decision tree in which it can be determined if AI could be used in a job. After starting from the top, answering all yes/no questions should lead to an answer to this question. In the following sections more information is provided on the different steps.

3.2.1 Routine tasks not requiring creativity

All ideas for using some form of AI start by focusing on one or more tasks in which using AI can improve efficiency, effectiveness etc. Fully autonomous robots that can perform an entire job without any human interaction are scarce. Therefore, the initial scope of an AI almost always has to start with performing some specific task of that job.

> *"The idea is to automate manual processes, that were repetitive and sensitive to errors." (Employee 2, 2020).*

Employee 2 named for example that an employee had to do a credit check on a possible loanee in order to approve it. However, this credit check has some pre-made requirements in order for it to be approved or denied. This is a basic routine task of just gathering the data and evaluating it to some requirements, something that an AI robot is more than capable of doing in less time than the employee.

Employee 3 confirmed the story, saying it depends on "the amount of repetitive and routinely character" (Employee 3, 2020) that is in an employees work in order to see if some parts of their jobs can be taken over by automation or AI. But the interviewee also indicated that not everything can be performed by AI.

> *"You still need skills like creativity and solving complex problems." (Employee 3, 2020)*

Some tasks still require more creative skills which is something that AI is not yet capable of. AI software can simulate creativity but that is always based on past data/behavior and therefore not true creativity. Customers will keep getting themselves in weird situations, situations to which AI will not be able to respond correctly because it has never dealt with something like that before. That is why in for example customer due diligence, some humans will always have to be present, to deal with the tasks that are not routine and require creativity.

The other interviewees stated the same things, saying its "the simple repetitive work" that gets replaced by robots and the work that has more "variety and needs creativity" will not (Employee 4, 2020). Employee 1 stated "it can do really specific things, so the task that it can do has to be really specific and well defined." (Employee 1, 2020), which has according to him a lot to do with the current state of development of AI, which is mostly really good in pattern recognition and is therefore best applicable to specific tasks.

When you have jobs that consist mostly of these routine/repetitive tasks and contain less to no tasks that require creativity, therefore are of a low skill variety, tasks identity and task significance, in which AI can then be applied more. Reaffirming the idea that these AI replaceable jobs will be impacted more by AI use and are more at the risk of becoming obsolete.

Looking at the 20 jobs found in the literature review, this criteria holds up for them all. Every single one of these jobs has a task or more that are routinely enough and in which applying AI can increase efficiency or helps the people perform better. For marketeers, this routine task is collecting information, for truckers/drivers it is driving from one point to the other and for pathologist it is collecting and analyzing CT-scans etc. Which was confirmed by employee 1, who said that next to his profession of radiologists using AI, pathologists are using AI as well.

> *"I know that our pathologist are using AI, they have somewhat similar infrastructure that is not as automatic, but can be fired up manually when they are working with pathologies and call up an algorithms that for example counts the number of nuclei or cancer volume or detects certain types of cells." (Employee 1, 2020)*

3.2.2 Having enough data

The second criteria might be forgotten sometimes but is actually very important. It is quite obvious that an AI works on the data that it is provided. However, there also needs to be a sufficient level of data available from the start to even begin training and developing an AI. Without this data, AI would have no reference points and therefore would be unable to make autonomous decisions.

> *"It (AI) has to involve a lot of data, because it is all about data. If you don't have a lot of data you cannot train AI and then it does not work." (Employee 1, 2020)*

For example, for pathologists using AI for genetic analysis, "there is a lot of data, it's all about pattern recognition. So, they will indeed start using AI" (Employee 1, 2020). However, if these AI algorithms would not have the data to be trained and have those reference points from the beginning, an AI would not know what to look for. The idea for an AI software or application might be good but if the company or developers do not have sufficient data available, the end product of AI will not be. This also references back to the previous point of AI not being able to do creative tasks. An AI cannot be creative because it cannot provide solutions for things that it has not analyzed in previous data, so if that data is not available AI cannot be applied.

This does resonate back the characteristic of job feedback in the job design theory. If a job has a lot of feedback in the form of data, it is easier to apply and train the AI because a lot of data is available for this. For example, for customer service reps their feedback consists of ratings/feedback from customers. An AI chatbot can use this data in analyzing what responses get good/bad reactions and be trained by this to help the customer in a better way.

This is also where one of the differences lies between AI and automation. As you can see in figure 2, if the tasks intended for AI are indeed repetitive and routinely but there is no data available, companies can still fall back on regular automation of these tasks. Automation does not need that large amount of data because it works on these simple tasks without human intervention, reacting only to its input data the way it was programmed to. Automation with AI can also work on these simple tasks but its task is not only to react to the input data, next to that it needs to actually analyze the data and provide insights based on the data, which in turn it can only do if it has been trained with sufficient other data. The literature review provided a good example for this, in manufacturing you can have a robot sorting apples from oranges better and faster than any human can, this is just simple automation. An AI trained robot can do the same task but will next to that, based on loads of previous data, predict when maintenance is needed, and it can predict this because it analyzed patterns in that previous data that it has been trained with.

Employee 3 has seen the automation grade rise because of the robots becoming more intelligent, also known as the development of simple robots to AI robots. He said that after the automation of the simpler routine tasks, now "still routinely tasks but more knowledge work" (Employee 3, 2020) is becoming more replaceable by robots. For example the work of credit risk analysts where AI robots can "after the data has been collected, give a reasonable rating based on the big data" (Employee 3, 2020), which leaves credit risk analysts at more risk of becoming obsolete. But again, there is the emphasis on "big data", as this work can only be taken over if this big data is available for the AI.

3.2.3 No empathy or caregiving needed

The last criteria is that the tasks for which the use of AI is intended does not require having to provide caregiving or show empathy. Tasks in which human contact is required and/or preferred are not optimal for AI use. Going back to the example provided by employee 3 of working with customer due diligence, he said that it always requires a human touch because when a customer finds itself in problems it wants to experience empathy from another human being.

> *"When a customer needs to have a conversation about the problems he/she has been having with Covid-19, he does not want to talk to a robot but to a human." (Employee 3, 2020).*

Therefore, you cannot let AI take over those tasks because customers would not accept it. Certain tasks, like answering simple questions, can be routinely and repetitive and be therefore handled by a chatbot. For example, the bank where employee 2 worked had started building a chatbot that could answer questions of employees regarding the amount of leave time permitted or send them to the correct location to find this information. But when customers find themselves with bigger problems or more complex situations, a human touch is still required to provide that empathy that an AI cannot give. Meaning that in customer service a lot of jobs will be lost, but not all, as some humans still need to be present.

This also means that in caregiving jobs, AI use will be limited. As people still require some form of empathy from their caregivers. Caregiving professions will remain a very human job until AI is developed so much further that it can become good at mimicking empathy. Employee 1 also indicated that for nurses the chance of AI Application therefore will be small.

> *"A nurse has a very complicated task. They have to estimate how well a patient is doing, they need to talk to the patient and show empathy, and those are not things AI can do." (Employee 1, 2020).*

If we look at the 20 jobs identified in the literature review, you can see that in all of them the tasks/jobs that AI is performing does not require that empathy or caregiving. That does not mean that those profession do not require that at all, for example a teacher still most definitely needs empathy. However, the tasks in which AI is applied, like analyzing student proficiency, and in which it can help the teacher, no empathy is needed.

3.3 Salary comparison

Another part of job design is the (financial) reward employees get for their job. In the analysis of the 20 jobs identified in the literature review we looked at the salary of all the jobs and found that there is a significant salary difference between jobs that stand to be augmented, and profit from the use of AI in their jobs, and the jobs in which people can become obsolete, or replaced by AI.

This difference was confirmed in the interviews as well. And whilst this is quite an obvious thing because the jobs that are at risk are the simpler jobs which require less education, it is still an important point to make and for people to realize. It is most definitely not recommended for people to educate themselves to become an administrative worker anymore, because judging by the research those jobs will become largely obsolete.

> *"Automation is going to hit people who earn less in the organization the most, and then mostly women." (Employee 3, 2020).*

Employee 2 said that within the banking sector a lot of people have become replaced already, she gave an example by saying "we are a sector that has been hit hard by automation, but also improved. Local banks have been minimalized because robots have simply taken over peoples jobs." (Employee 2, 2020) These are the low paid jobs like administrative workers or customer service reps that were at the desks at those local banks. But for the higher paid jobs, AI has mostly freed up those workers from doing those dull tasks and therefore having more time to perform better at other tasks. The goal for AI in those jobs was more to relieve workers and to make their jobs more interesting and fun, and the workers more efficient.

The "nationaleberoepengids.nl" website was used to find out the average salaries of the jobs in this study, based on the salaries in the Netherlands. The job of the farmer was left out, because in that job the farmer does not really earn salary as he is basically an entrepreneur. The average gross salary was taken based on the jobs that fitted the description of the jobs in the literature review the best, appendix B shows the exact salaries used. And whilst this is definitely not the best way of analyzing this and the absolute number are probably not 100% correct, the image this analysis has given is most definitely correct based on the research and is a helpful visualization of the findings.

Figure 3: Salary comparison

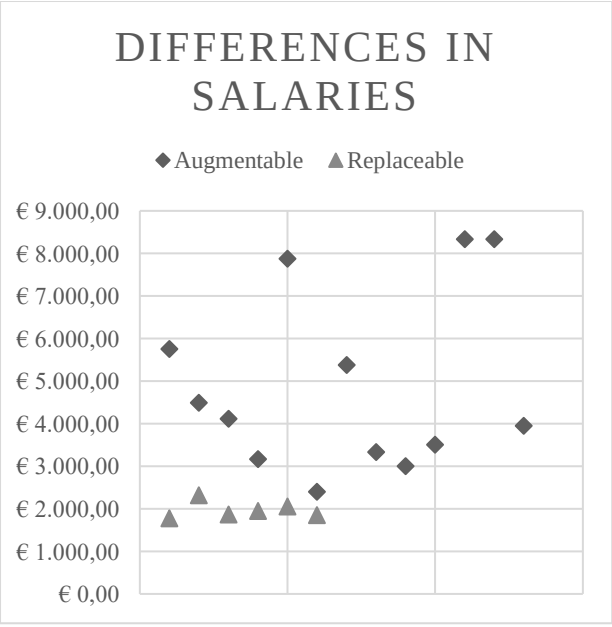
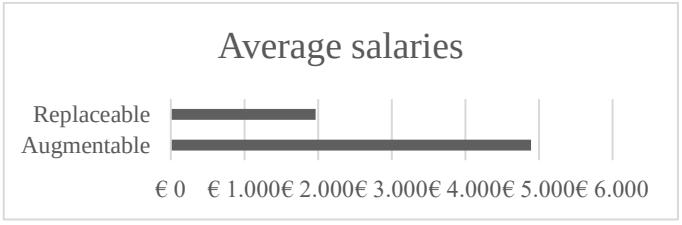


Figure 3 shows the large differences there are in salaries for AI augmentable (circles), and AI replaceable jobs (triangles). Besides the job of banker, for which the salary of a financial advisor was used, all the augmentable jobs are above €3.000 euros gross per month. As displayed in figure 4, the average for replaceable jobs is around €1967 euros, whilst the average for augmentable is €4894 euros, this being about a 2.5 times as large.

Figure 4: Average gross salaries



This goes to show that for jobs with a lower financial reward, the risk of becoming obsolete and being more heavily impacted by AI is higher. This is of course a development that will become clearer over time, but with the current rate of AI development this could cause some issues for these lower paid people.

3.4 Future of work

In all of the jobs that will start using AI, the employees have to find a way to work together with the AI, or to develop other skills when their old skills are not necessary anymore. This is another thing that was noticed in the research, the future way of working will change, and people need to change with it in order to not get left behind. What came forward in the interviews is that they believed employees do not have to become obsolete as long as they actively participate in learning new skills. Whilst it is true that as employee 2 said "our IT recruiters have been very busy, whilst at local banks a lot of people have had to leave" (Employee 2, 2020), this does not mean that those employees cannot find a new place within the organization. Employees need to focus on attaining these new skills, in order for them to remain a part of the organization.

> *"Creativity, emotional intelligence, storytelling, contextual problem solving, learning agility. Those are the important skills for the future, and our employees need to learn these" (Employee 3, 2020; Employee 4, 2020).*

This movement of reskilling employees and having them work more flexible across the organization is a likely scenario for a lot of companies in the future. Because of course any company wants to reduce costs as far as possible in the future we might see that "human capital is only used for things which you cannot automate" (Employee 4, 2020). Which means that the tasks that remain for humans to cover might be spread more throughout the organization and therefore, will see employees becoming more flexible and more deployed throughout the organization instead of sticking to one role. This does mean that job design will become a more complex task, because a job will consist of more different tasks in perhaps more different departments. Which will lead to complex issues considering: what kind of function exactly someone has. Or in the case of working in/for different departments, which department is responsible for their salary.

> *"I see that the idea of deploying employees more flexible is getting stronger, and the old idea of having employees focused on that specific set of tasks is getting less dominant." (Employee 3, 2020).*

This development is already seen within organizations as employees are actively reskilling themselves. Employees seems perfectly capable, after some short refresher course, to be deployable in completely different areas in the organization. Organizations are educating employees to become more actively involved in the development and building of the robots or automation, which leads to for example employees saying "I used to do administrative work, but now I program robots", or alternating from a front desk job at a local bank to working in a marketing team (Employee 3, 2020).

The interviewees also noticed that because of this active participation of employees in the development of automation and AI, the fear of robotics has been reduced amongst employees. This initial fear, which was seen by them 3 years ago, of employees being afraid for job-loss, has been largely replaced by enthusiasm. Employees are actually coming to management teams these days with initiatives saying "can we not automate this?" (Employee 2, 2020). Involving people in that process of automation is key to it being regarded as positive, because they actually acknowledge that the pressure of their daily work is reducing, and they have more time to do qualitatively more fun work.

However, change will not solely come for employees, management will have to change with them. This idea of deploying employees more widely across the organization has to be facilitated by the management team. This for example means that an organization must "train managers a lot more on skill coaching and skill collaboration" (Employee 4, 2020), in order for them to help employees in making that change. The old situation of line managers solely focusing on KPI's and telling employees exactly what to do is not relevant anymore. The new role is more of facilitating employees in working more lean and agile, and this is of course a change managers have to make. Where AI software that can take over management roles is "something we at the moment can only dream of" (Employee 3, 2020), management does need to help employees in adapting to their new roles. This also means that the "director of the future" (Employee 4, 2020) needs to know the abilities of automation and AI and have a vision on its role in the future, in order to be successful.

4. DISCUSSION

4.1 Conclusion

The purpose of this paper was to give an answer to the question *"What are the criteria for jobs to be supported by Artificial Intelligence?"*

Based on job design theory we found that hard criteria could not be constructed, the only finding was that low skill variety, tasks significance/identity and autonomous jobs are more at risk of becoming obsolete. Based on simpler job design, being what kind of tasks a job has, results show that the main criteria for jobs can be limited to these three, 1. Having one or more tasks that are routinely, repetitive and do not require creativity. 2. Having enough data to train the AI. 3. No empathy or caregiving needed. These finding are interesting, as they show that actually the use for AI is pretty broad as long as you can find some specific tasks for it to do, meaning that the barrier for AI use in jobs is not that high. In the 20 jobs analyzed, the differences in functions and characteristics were large but all of them were able to apply AI, and the interviews confirmed this view of AI's dominance in the workplace in the upcoming years. Next to answering the original research question, the paper also shows that for lower income jobs, the implications are going to be more probable and drastic and these people may become obsolete over time. The research also shows that the future way of working is going to change drastically over the coming decade and people need to be ready for it. Employees and management need to develop different sets of skills in order for them to stay relevant in their respective organizations.

The theoretical implications result from the added information on job design for jobs that can use AI. If organizations have jobs that are low in skill variety, task significance/identity and low autonomy the chances are high that those jobs can become or are largely influenced by AI. This study therefore adds to the research on AI in job design by saying that those jobs may not be a human job anymore in the future. Next to this, this study added criteria for tasks that a job should have in order for AI to be used. These criteria can be used in further research on job design for AI-supported jobs. In the area of human resource management, this research adds to the idea that jobs and job design will change drastically because of the development of AI. It provides a theory that almost all jobs will become influenced by AI and that it depends on the level of skill variety and therefore the kind of tasks a job contains how heavy this influence will be.

The practical implications of this research are that it shows the possibilities for AI, but also the threats for certain professions. And with that threat, a call to action for people to start working on their skills. The decision tree can be used by people to see if their jobs can become AI impacted in the future. And if so, they can look at the skills needed for them to stay relevant.

4.2 Limitations

The limitations from this research come from its limited size, during the Covid-19 crisis going out to interview people was difficult. A larger research that could look at more jobs and have more interviews which could give a more precise view of the AI implications. Another research that would look at more jobs might come to another conclusion or find more criteria. Also, conducting more interviews with more people from different job sectors could provide that research with more examples and insights to build upon.

4.3 Further research

Further research could point out whether the further development of AI will turn into a large unemployment issue or if the amount of jobs that AI also provides makes up for the ones it takes away. Also, it would be valuable to many people/organizations to have an indication of the development of AI. This research predicts that low skill variety jobs will become obsolete in the future, a research that can give an indication of the expected pace of this development could be very useful. The last further research idea would be researching exactly what kind of skills people need to work in an AI influenced organization. This research has given a small indication, but a larger research into this could turn out helpful insights in the future way of working.

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7. APPENDIX

7.1 Appendix A: Example interview questions

1. Which profession do you not see use AI in the future?
2. So criteria for you for AI to be applicable to a job would be that it needs to have some form of a repeatable task?
3. What do employees need, to work efficiently together with robots/AI?
4. Do you also see resistance of employees regarding appliance of robots/AI in the workplace?
5. Do you also encounter differences within departments regarding robot appliance?
6. What do employees need to work in this changed (By AI/robots) work environment?
7. Would you say there is a change coming in the nature of work for employees?

7.2 Appendix B: Gross monthly salaries

Augmentable	Gross monthly salary	Replaceable	Gross monthly salary2
Supply chain manager	€ 5.750,00	Assembly line worker	€ 1.775,00
Policy maker	€ 4.488,50	Administrative worker	€ 2.312,50
Teacher	€ 4.111,50	Taxi/Uber driver	€ 1.862,50
Engineer	€ 3.168,50	Trucker	€ 1.950,00
Accountant	€ 7.875,00	Delivery driver	€ 2.050,00
Banker	€ 2.400,00	Customer service rep	€ 1.850,00
Trader	€ 5.375,00		
Marketeer	€ 3.333,00		
Line manager	€ 3.000,00		
Recruiter	€ 3.500,00		
Surgeon	€ 8.333,00		
Radiologist	€ 8.333,00		
Pathologist	€ 3.950,00	Farmer	N/A