

BACHELOR THESIS
ARTIFICIAL INTELLIGENCE

Radboud University



Managing AI in Management

Author:
Evelien van Dijk
s1006693

First supervisor:
Dr. O. Guest
Artificial Intelligence,
Donders Institute
Olivia.guest@ru.nl

Second supervisor:
Dr. G. Mecacci
Artificial Intelligence,
Donders Institute
g.mecacci@donders.ru.nl



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Abstract

In this thesis, the application of Artificial Intelligence in management is discussed. Artificial Intelligence is used in organizations to provide more efficient production, but it is not used yet as a management tool. In this thesis, a review is given on what opportunities lie for AI within the field of management. Part of this research provides an explanation of two theories of management, discussing which characteristics of these theories can be substituted by AI. It shows that multiple characteristics can be replaced by AI, which gives an opportunity for AI to be implemented here, especially with monitoring. Next to this, this thesis gives an overview of the research already done with regard to AI in management. This overview provides a review of decision-based systems, feedback systems, and algorithmic management. These applications show that next to other tasks, the objective tasks of managing can be replaced by AI. Moreover, some of the ethical concerns related to the implementation of AI in management are discussed. Trust is of great importance here, and research shows that people have an initial lack of trust in AI. To resolve the issues regarding trust in management and AI, a conceptual analysis is provided of four concepts of trust. Lastly, the results of a case study with an expert in the field of management are discussed. This case study gives an insight into the reaction of an expert in the field to the use of AI in management. It shows that there is apprehension about this development, as it raises many concerns, such as loss of power, and other ethical concerns. The implementation of AI in management will need much more research before it can be considered, because of the concerns associated with it. Nevertheless, this thesis serves as fundamental research of where the opportunities lie within this field.

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Chapter 1

Introduction

Management is the art, or science, of achieving goals through people [35]. Management can be found everywhere in daily life. With management, people can coordinate, organize, and plan activities, wherever this can be applied. In the field of management, many different theories have been developed on how to manage organizations. There are many different opinions on what is the best way to manage, and there probably is no best way of managing. This is because the field of management is built up from many different aspects, and it is still developing every day. I wanted to dive into this research, as I think AI can be beneficial to management. Management involves objectivity but also a lot of subjectivity. Some employees might receive better treatment than other employees. By researching the use of AI in management, the subjectivity will be reduced, and as AI can adapt to company-specific cases, it can be efficient in all different situations.

For many people, Artificial Intelligence (AI) still seems like a new concept, even though it has been around for many decades, and will be around for many more to come. Artificial Intelligence is integrated into many different situations in daily life, and more implementations of AI are used everyday.

For over a few decades, research has been done on implementing Artificial Intelligence systems within the field of strategic management. AI systems are already broadly used for making decisions based on data knowledge, but little has yet been applied to management. What if AI-based decision-making is used to make important decisions regarding the management of an organization? What will happen if a manager is substituted by AI, or has to cooperate with AI? This thesis dives deeper into this subject. From the Industrial revolution on, machines have been used in the production process of companies, and these machines have been replaced by computational systems that can think for themselves.

Research has shown that the implementation of machines in the production process can greatly improve the efficiency and therefore increase a company's profit. However, using such machines in management has not been researched much yet. This thesis adds to this topic, researching where using AI in management can be beneficial. This thesis gives implications for the change of the future of management in regard to AI.

Many strategic decisions made within an organization have a subjective background and depend on specific situations. Management is about solving problems that keep emerging all the time in the course of an organization struggling to achieve its goals and objectives [35]. Managers in organizations are expected to react quickly and correctly in stressful or chaotic situations, and come up with decisions fast when necessary. Moreover, managers are expected to take care of their staff, and with Human Resource Management, managers are expected to keep their employees up to date with a companies development and lay them off if this is not the case. Finally, managing is concerned with productivity – this implies effectiveness and efficiency [35]. Therefore, if Artificial Intelligence is to be implemented within management, all of these managerial tasks should be considered in order to research where AI can play a role. Therefore, the research question of this thesis is: “To what extent can AI be used within the field of management, and to what extent do we want it to be used here?”.

The aim of this thesis is to research the implementation of AI systems within the field of management, and to see to what extent this is wanted and efficient. Management consists of many different aspects and is influenced in many ways. This thesis will not focus on all aspects of management. This thesis mostly focuses on the general impact of AI in management and zooms in on two theories of management. Fundamental research is provided on AI in management and a view is generated on what steps need to be taken in order to implement AI in management.

Looking at different theories of management, namely bureaucratic management and scientific management, which characteristics of these management theories could be replaced by Artificial Intelligence systems is analyzed. This exploratory approach gives a new and different view of implementing AI in management, as it looks at the original theories of the core of management, where Artificial Intelligence has not been applied yet. This can be found in Chapter 3.

After zooming in on these theories of management, more general applications of Artificial Intelligence in management are discussed and analyzed in Chapter 4. A selection is made of AI-generated feedback systems, AI decision-based systems, and algorithmic management. This selection provides an analysis of the systems researched. The application of AI in recruitment is also briefly discussed.

It focuses on the bias in recruitment, and how AI can reduce this bias. Nevertheless, this thesis does not go into depth on this topic, as AI in recruitment can be reviewed as a subject in itself.

When researching different methods of implementation of AI in management, it is important to consider its ethical and social impact. It can be questioned if this is something employees want or will accept; will they trust an AI system to make judgment calls based on their work, or would they rather have humans make these decisions? From this the question follows if using an AI system is the best option, or should this kind of innovation not be used for strategic management? This is all considered in Chapter 5. Here, I defined a conceptual analysis on concepts building towards trust, namely judgment, People Analytics, fairness, and emotional relation.

As an extension of the research in this thesis, I conducted a case study to get a view of an expert in the field of management. Here, an insightful view is provided to the research of what an expert in management actually thinks of the implementation of AI. It adds to the research as it is a new field still to be discovered. Although research can already give many implications for using AI in management, an expert in the field can give a realistic opinion on this matter. The results of the case study are discussed in Chapter 6. This thesis ends with a conclusion of what research is provided in this thesis and gives a perspective on limitations and opportunities for the field of AI and management.

Chapter 2

Preliminaries

Management is the process of designing and maintaining an environment in which individuals, working together in groups, efficiently accomplish selected aims ([23] as cited in [35]). Management can be applied to many different situations, however, this thesis focuses on management in organizations.

In general, the functions of management are defined as planning, organizing, staffing, leading, and controlling [35]. All of these roles are equally important, although management goals can deviate between organizations. Nevertheless, the logical and publicly desirable aim of all managers in all kinds of organizations, whether business or non-business, should be a surplus [35]. Thus, the main goal of management is making sure the goals and objectives of an organization are accomplished, doing so with lowest costs and waste. This implies that a manager should ensure productivity, as this will lead to efficiency and effectiveness.

For a manager to be able to be successful, some general skills a manager should have are organizational skills, technical skills, and human skills. An important part of managing is being able to quickly react when necessary in chaotic or stressful situations. Moreover, a manager should understand its employees and should be able to select the right employee from a group of employees for a certain task. The manager should be able to assess its employees' skills and use these skills as efficiently as possible.

Another concept of management that is discussed in this thesis is Human Resource Management. Human Resource Management should be based on strategic integration of human resources, assessment of workers, and exchange of ideas between shareholders and workers [35]. Therefore, a manager in this field should be able to assess the qualities of employees and should decide to lay off an employee if this employee does not have the skills needed anymore for a function. Moreover, a manager should seek to add new employees to a company if found necessary. Thus, a manager should notice if certain skills are missing to obtain maximal efficiency and productivity.

Chapter 3

Theories of Management

Many different theories of management have been developed, all describing a strategic plan and view on how to manage an organization. All theories have a different approach and practical outcome. In this section, two theories of management will be reviewed to see where Artificial Intelligence could play a role in the practical application of these theories. Insight is given on how Artificial Intelligence can be embedded within the core of management and where AI is not applicable within these theories. This exploratory research gives a new angle of view for AI in management as it is not built on previous research. The theories discussed are bureaucratic management and scientific management.

3.1 Bureaucratic Management

Bureaucratic management is mainly focused on the organizational structure of an organization or company. Bureaucracy entails that the goals of an organization are set, all activities are official tasks, all functions within the organization are specified, there are predefined rules and regulations, and there is a clear authority. This results in a high level of specialization, formalization, standardization, and centralization of power at the top of an organization. Max Weber first introduced the bureaucratic management theory. Within this theory, Weber focused on hierarchy and authority-control strict lines in structuring the organization into a hierarchy [33]. The main focus of bureaucratic management is to have strict rules and regulations within an organization which all employees should follow. Weber suggested that organizations should develop precise and comprehensive operating procedures to do predefined tasks [33]. Weber defined six characteristics of bureaucratic theory, as described in table 3.1.

1	Functions are defined by law, and thus formalised by written rules and regulations.
2	There is a clear hierarchy of authority, with observance of the legitimate order.
3	Assessment and selection of employees for their technical competence.
4	Formal social relationships according to the position held.
5	Employees' regular wage is stable, and they have a retirement income upon retirement.
6	Division of work with high specialization and standardisation of the functions to perform.

Table 3.1: Characteristics of bureaucratic management [40]

This approach to management according to Weber is very formal and objective, and thus the subjective reasoning of individuals is not to be considered within this theory. Considering this, it seems that computer systems could fit well in bureaucratic management. To review AI-usage within bureaucratic management, all characteristics from Table 3.1 are discussed.

The first characteristic, Table 3.1 first row, describes that there are written rules and regulations by which the functions of an organization are formalized. The performance of employees can be controlled because this is enforced by certain rules and controls that are present. A big concept that plays a role within bureaucracy is monitoring. Monitoring plays a role here as it can control the performance of employees. Leveraging big data analytics and self-learning capabilities, AI applications can track employees' activities at work, evaluate job performance, and generate recommendations for changes that could improve employee productivity [42]. In this way, the monitoring is performed by AI applications. Therefore, part of this characteristic can be performed by AI.

The second characteristic, Table 3.1 second row, indicates a clear hierarchy within an organization and the order of this hierarchy to be observed, such that it is not violated. Keeping a clear hierarchy is mostly the task of the people within a hierarchy, making sure that people below them in the hierarchy listen to them and that they have authority. If this is done correctly, a clear chain of command will be present. Nevertheless, the observance of such a hierarchy can also be partially controlled by monitoring, which as mentioned before can be provided by using AI systems.

The third characteristic, Table 3.1 third row, is assessing and selecting employees for their technical competence. This means selecting the best-fitted people for a certain function based on their skills, or reviewing the performance of employees and promoting them accordingly. AI systems can maybe play an even better role in this characteristic than humans, as a selection process of employees can be biased when done by humans. If this were to be replaced by an AI system, an applicant would solely be selected on their technical skills and if these skills fit the function best. AI is unbiased and screens resume fairly by giving equal weight to all candidates [43]. Thus, this practical implementation of this characteristic can be replaced by AI systems.

The fourth characteristic, Table 3.1 fourth row, describes the formal social relationships employees should have within an organization, according to the hierarchy that is present. This concerns the impersonality that is expected from employees within bureaucratic management. As this is something that is to be followed and adopted by a person themselves, it is hard to be replaced by an AI system. Moreover it is not particularly necessary. However, again monitoring plays a part here, as the digital communication of employees to other employees can be observed by an AI system, and thus intervention can be done if necessary.

The fifth characteristic, Table 3.1 fifth row, concerns the employee's salary and its stability, and that employees receive the correct retirement income upon retirement. Currently, this is already handled by a computer system, in the Netherlands by the Dutch pension system. Thus, Artificial Intelligence is not needed within this system, as it is solely something that needs to be kept track of, and no other actions have to be made. Therefore, no self-learning machines are necessary here.

The final characteristic, Table 3.1 sixth row, is the division of labor with specialization of tasks and standardization. This entails partitioning tasks such that employees can focus on a certain task and that the final product is built more efficiently. It has already been proven that robots can do small tasks and thus replace humans in this process. The successful deployment of presently over one million industrial robots has rested traditionally on a number of factors: on repeatability as a tool to achieve consistent quality, on the speed and force they make available to manufacturing processes, on the flexibility brought about by programmability, on the possibility to delegate hazardous production tasks to machines to a greater extent, and also on the reduction of the manufacturing work force [15]. Thus, simple tasks are easily replaceable and many jobs have already been replaced by robots, which results in deskilling within companies. More complex tasks might also be able to be replaced by AI systems, as the rise of AI's capabilities will result

in the augmentation and automation of cognitive tasks [6]. Therefore, this characteristic may be accomplished by AI systems.

Reviewing these characteristics shows that most of the practical implementations of them could be replaced by AI systems. Therefore, as expected, bureaucratic management as a whole has a great chance of being suited for AI systems. A negative aspect of bureaucratic management is organizational red tape. According to Rosenfeld ([37] as cited in [13]) red tape is defined as:

“Guidelines, procedures, forms, and government interventions that are perceived as excessive, unwieldy, or pointless in relationship to decision making or implementation of decisions.”

This red tape comes with bureaucratic management because of the formulation of strict rules and regulations. This causes a lot of administrative labor. While humans have certainly improved their administrative abilities over time to match the changing demands of modern society, there is no question that human administrators are limited in their capacities and deeply flawed in their pursuit of efficiency, effectiveness, and equitable administration of the law [6]. Therefore, the administration of all the red tape can be overwhelming to humans. To overcome this, digital systems can be used to handle most of this red tape, and take away this negative consequence of bureaucratic management. These systems can process all the administration, and have much more, sometimes even unlimited, capacity to handle all the data.

3.2 Scientific Management

Within scientific management theory, much concentration was put on the methods that can improve the productivity, efficiency and effectiveness of workers along with their performance [21]. The three principles of scientific management are the decoupling of the labor process from the skills of the workmen, all possible analytical brain work should be aimed at planning or layout department, and the management team should not rely on the workers to decide how they carry out their tasks [44].

This view on management was developed at the beginning of the 20th century. During this period, Frederick Taylor adopted this theory to manage workers. Taylor’s postulations were strongly influenced by his social/historical period (1856-1917) during the Industrial Revolution; it was a period of autocratic management that saw Taylor turning to “science” (hence, his principles of scientific management) as a solution to the inefficiencies and injustices of the period [35].

Thus, at this time scientific management was found to be successful to the economy, as it improved productivity. Nevertheless, criticism was raised on this way of working, as there was a strong division of labor and employees had little or no opportunity to exercise control over their work. Nowadays, the traditional form of scientific management is not used much anymore, but principles of it are still adapted within organizations. Therefore, it is interesting to see which parts of these principles can be adapted by using Artificial Intelligence systems.

Taylor implemented the three principles of scientific management to form his view on these. Taylor developed four principles of this view of scientific management. These principles can be found in table 3.2.

1	Developing an original scientific management method to decode the best method for performing a task.
2	Systematic recruitment of employees for executing a task who can be given responsibility for which he or she can best suit.
3	Scientific education and development of the worker.
4	A mutual friendly cooperation that exist between the management and the labor.

Table 3.2: Principles of scientific management [21]

The first principle, Table 3.2 first row, describes the development of a true science within management. A true managerial science would ensure the efficiency of the workman in various ways [44]. One way is that a true science will form adequate rules and regulations that need to be followed regarding the production. Next to this, a true science makes it possible for the standardization and perfection of the working equipment [44]. This will increase productivity within an organization, which will lead to more profit. Another aspect regarding this principle is workmen needing some form of motivation to keep them productive at their work. Most of the time, this is a monetary motivation. Such a motivation will lead to more productivity of the workmen.

A true managerial science can be implemented more efficiently by automation. Automation is ensured by machines replacing the work of employees. An example is Amazon changing their warehouses to be fully automated. Thus, all packaging, sorting, and selecting is performed by automated robots. The robots used in this specific case are Kiva robots. Kiva robots have allowed automating many tasks, transporting the products across the Amazon warehouses and delivering the goods directly to the workers, improving efficiency and optimizing the work process [29].

By introducing these robots, rules and regulations are followed in a strict manner, as these machines are programmed in a way to only follow these rules and regulations. The employees working with the robots have to follow the same rules and regulations, otherwise the production process is not followed accordingly. Therefore, Amazon owners have formalized the work (abstraction of the work) transforming the labor process into a list of rules that the workers have to follow [29]. In this way, by using automated machines, the enforcement of rules and regulations is controlled, and this principle is enforced.

Amazon is trying to remove the decision-making process of each employee through software and games, using the control of conception to dictate how work has to be done in the warehouses [29]. These software and robots managers can dictate how work has to be done and at what speed [29]. Developing this further, by applying machine learning these machines could be fully self-controllable. From this, it follows that machine learning, and thus Artificial Intelligence, can be implemented within this principle, and can even increase the efficiency of the practice of this principle.

The second principle, Table 3.2 second row, concerns selecting the right person for each function, and also firing employees not suitable for a function anymore. Scientific methods of selection are used for recruitment to find the best-suited person for a function. All organizations want to strive to find the best person for a job, and therefore different rounds of selection are needed for recruitment. Next to this, it is important to notice if an employee is not right (anymore) for a function and act on this by letting this employee go. Selecting these employees can, as can the recruitment of new employees, be done by making use of scientific methods. Each employee, therefore, strives to work harder and more efficiently in order to avoid being eliminated from the organization [44]. However, an important aspect of this principle is that Taylor contends that it is the responsibility of the employer to train employees and ensure they are fit to handle the responsibilities assigned to them [44].

Using scientific methods for the recruitment process opens a window of opportunities for Artificial Intelligence. The recruitment process usually consists of multiple rounds. As a first step, AI can be used to find a qualified person by collecting and selecting data and using this data to search for a fitting candidate. Next, AI can be used to scan the resumes of applying candidates. AI recruiting software grades and ranks the resumes for skills, experience, and other qualifications and responds with an affirmative or rejection message within 24 hours of the receipt of application [43]. In this way, the hiring process is sped up because AI can perform this activity much faster than humans can. After reviewing the resumes, the interviews are best to be taken by human recruiters, as this does not consist of standardized questions and this is a subjective part of the selection.

Another important aspect of this principle is reviewing if an employee is not right anymore for a job. By monitoring the work of the employees, managers can check this. To notice this faster, the monitoring can be done by AI. AI-generated feedback systems can be used to collect performance data from employees. A manager can review the results of such a system and make a fair decision. For this principle, it is explicitly stated that it is the responsibility of the employer to train employees. Thus, although the actual training can be done using digital systems, the organization and control of this should still lie with the managers of a firm.

The third principle, Table 3.2 third row, includes the importance of the updated scientific education and development of the employees. As described in this principle, it is the responsibility of the employer. Nevertheless, this is not only the responsibility of the employer, but of the organization as a whole. An organization needs to make sure that employees remain up to date in their function in order to stay profitable and efficient. The implication of this principle is that workers have to constantly undergo training and development in order to be more efficient in performing the tasks assigned to them [44]. In practice, it can be seen that many organizations host in-house training for employees, and sometimes even offer education next to the employee's work. In this way, employees are able to gain relevant knowledge during their work.

The training of employees can be provided by digital systems. Using feedback systems, an AI system can select the fitted training per employee, and provide this training. In this way, all employees receive personalized training which is important as all employees have their own strengths and weaknesses. If AI monitors the workflow of employees and notices changes in the production process, the education of employees can be updated accordingly. Letting AI do this instead of human coordinators results in noticing small changes that can have a substantial role in the flow of the production. Human coordinators might have not noticed these small defects, and thus by using AI the production process can be more efficient.

The fourth principle, Table 3.2 fourth row, entails there exists cooperation between employees and the management. Taylor explains that his intention is for a clear division of labor between the groups, with the management team responsible for all the planning and cognitive functions [44]. He further believed that the workload would be evenly shared between the workers and management with management performing the science and instruction and the workers performing the labor, each group doing "the work for which it was best suited" [35]. This principle includes determining the best way of working and maximizing the efficiency of doing a certain task. This was analyzed by performing a scientific study. This scientific study entailed having someone time employees with a stopwatch, while they were doing

a specific task. The best 10 to 15 employees then were selected for doing this task. The next step is to analyze the exact series of operations needed while doing the work under investigation, as well as understanding the tools which are used [44]. By analyzing this, the unnecessary and least efficient operations and tools are eliminated from a task, and therefore efficiency is maximized. Such a scientific study results in division of labor being central to this principle. This is because the cooperation between employees and the management provides a suitable working environment for distribution of tasks among the employees according to their skills and qualifications [44]. It might seem simple to perform a scientific study by using digital systems, as tracking and monitoring can be done by cloud computing. Cloud computing allows automated systems to more accurately track, monitor, and store production data for assessment by quality control specialists and inventory programs ([28] as cited in [22]). Although having a clear view of the production and where it can improve is crucial, nowadays a scientific study of this form is not considered ethically correct to control this. As cloud computing already improves the production process, without tracking the individual work of employees, scientific studies can be removed from organizations. Next to this, division of labor is central within this principle. With current technology, a machine cannot puzzle through a complex task on its own without assistance from a human operator or by simple computer algorithms [22]. However, the likelihood of a task being accomplished increases when it is broken down into simpler movements [22]. These separated movements are easier to be replaced by a machine and as such the production process is automated and developed more efficiently. By using a computer algorithm, these separate movements can be combined to work together, and thus the whole production process can be replaced by machines. This opens a larger production-possibility landscape that would have previously stagnated because of the inherent limitations of human workers [22]. Nevertheless, the focus of this principle, which is the efficient cooperation between employees and management, is switched when approaching it in this way, as the employees are to be replaced by machines, and if this continues, (a part of) the managers as well. Thus, human cooperation does not exist anymore. However, if one would not consider cooperation as something where humans must be involved, one could conclude that the “employee machines” and the “managerial machines” are actually working together in a perfect manner and that this digital cooperation is optimized.

Chapter 4

Applications of AI in Management

For many years now, companies and organizations have adopted their strategies and production processes by implementing intelligent technologies to improve efficiency and to have lower costs, which results in higher profit. Until now, this has prominently been done in the bottom layer of organizations. An example of this is the change in warehouses. Where previously employees would sort and pick products from a warehouse to be distributed, this is now being replaced by robotic machines sorting and ordering all the packages. By using technology to enhance the workflow of a company, the management of a company changes. A different style has to be adopted to ensure efficiency. Nevertheless, the management of a company is in this way still controlled by humans.

When looking at technological changes higher up within a company, Artificial Intelligence can be used to support employees in doing their tasks. For instance, help desks within companies are changed to be handled mostly by Artificial Intelligent systems. For example, this was done by an Italian insurer company. Within this insurer company, a cognitive help desk was developed. The system engages with employees using deep-learning technology to search frequently asked questions and answers, previously resolved cases, and documentation to come up with solutions to employees' problems [10]. It uses a smart-routing capability (business process automation) to forward the most complex problems to human representatives, and it uses natural language processing to support user requests in Italian [10]. In this way, Artificial Intelligence is used as a chat-bot tool to support employees. This creates an environment where the management of a company could have fewer problems as most questions can be handled by the cognitive help desk.

When hearing about such a new development, it might be noticed that it actually does not involve using AI within management. This example does use AI within the company, but the management of that company is not replaced yet by digital systems. Till now only little research has been done on actually using AI within management. Nevertheless, there are a few cases where this has been studied. In the next subsections, I selected a few of these AI-based concepts within management.

4.1 Feedback Systems

There are a few examples where feedback systems generated by AI are used to give feedback to employees instead of managers providing this feedback. Advances in deep learning and neural network techniques empower AI to perform the managerial task of feedback provision, which entails not only tracking employee performance but also generating customized performance evaluations and personalized recommendations to improve employees' job skills at scale [42]. Using AI to generate the feedback can give more broad and personalized feedback, as data can be collected faster, and a broader scope of data is collected. By using these systems effectively, thousands of employees can be provided with feedback at the same time. AI can increase the quality of employee performance assessments than human managers can, by more accurately and more speedily analyzing a wider range of data on how employees perform on the job [42]. Thus, feedback can be given faster as AI encompasses the ability of managers to do this at this speed.

To see what effects such a system has on a company, Tong et al. studied this effect and showed their results in the paper “The Janus face of artificial intelligence feedback: Deployment versus disclosure effects on employee performance” [42]. In this paper, they compared the effect on employees of human feedback to the effect on employees of AI-generated feedback. This AI system was enabled by state-of-the-art deep learning neural network-based speech analytic algorithms and trained with an enormous, archived data set of recorded collection calls, and human managers' feedback recommendations (FRs) from similar firms in the industry [42]. The experiment consisted of employees receiving feedback in different conditions; for example, they received feedback from AI systems knowing it was AI, but also from AI systems thinking it was a human manager. Reversed conditions were used as well with respect to human managers. The researchers expected and found two effects: a positive deployment effect (higher quality feedback, which, in turn, leads to greater employee productivity [42]), and a negative disclosure effect (reduce employees' productivity once they are informed of the act of using AI—relative to human managers—to generate feedback to them [42]).

This shows that employees are apprehensive towards feedback generated by AI and do not trust the system enough to fully commit to it. The researchers conclude that such a system can be in better use as a managerial assistant instead of fully taking over the managerial tasks. That is, companies can use AI as an effective managerial assistant that conducts data analytics and provides feedback content to support human managers' interactions with employees, thereby keeping humans in the loop [42]. Nevertheless, the research also stated that employees working for a longer time at the company had less trouble receiving feedback from the AI feedback system. This shows that there is more room for improvement where the AI system can have a bigger role in a company as a managerial function.

Another example of such a system was introduced in a paper by Luo et al. in which they introduced Artificial Intelligence coaches for sales agents [27]. AI coaches are computer software programs that leverage deep learning algorithms and cognitive speech analytics to analyze sales agents' conversations with customers and provide training feedback to improve their job skills [27]. The main concern in this research was if employees would be able to comprehend the coaching provided by AI and if it would be effective. To research this, a distinction was made between top-, middle- and bottom-ranked agents, and the effects of AI coaching were studied. The results showed that the middle-ranked agents had the most benefit from the AI coaches. Bottom-ranked agents encounter the most severe information overload problem with the AI coach, which leads to less learning from the coaching feedback and thus limited gains [27]. By contrast, top-ranked agents display the strongest AI aversion problem, which obstructs their incremental learning and performance [27]. The study suggests having an AI coach and human manager working together, as this collaboration has better effects for the top-ranked and bottom-ranked employees. Especially for the bottom-ranked agents this is most beneficial, as they do not comprehend the AI coach. Thus combining an AI coach with human managers gives them a better understanding of the feedback they receive. This research concludes that for now, the best solution is having the AI coaches work hand in hand with human managers. Nevertheless, I think that if these AI coaches are improved by learning, they can adapt themselves more to the bottom-ranked agents, and become more comprehensive for these agents. In this way, these bottom-ranked agents do not need the support of human managers anymore, and thus the AI coaches can provide full-rank feedback. Nevertheless, such a transition should happen gradually as otherwise bottom-ranked employees can feel overwhelmed by the use of AI coaches.

4.2 Decision-based Systems

Machine learning can be used to make decisions and predictions. The simplest form of this is that the machine is given some kind of input, it handles this data, and gives some sort of output. Nowadays Artificial Intelligence is used in many different ways to predict outcomes. This method of decision-making has already been used within companies. For example, AI tools such as expert systems and predictive analytics provide affordances for well-deliberated calculations that integrate otherwise unmanageable amounts of data; these tools produce analyses and help evaluate alternative decision options [19]. As discussed previously, decision-making systems are used as part of the recruitment process of new employees, where people are selected based on requirements for a specific function. Moreover, decision-making systems are used as a tool to review past mistakes and base new decisions on the mistakes to correct them. Such AI algorithms can encompass humans in the sense that data is collected faster, and thus certain patterns are recognized more easily. Machine Learning algorithms have made it possible to train computer systems to be more accurate and more capable than those that we can manually program [5].

Decision-making algorithms make a prediction based on data, which is an important aspect of such an algorithm. Effective decision-making also requires collection and organization of data, the ability to take an action based on a decision, and the judgment to evaluate the payoffs associated with different outcomes [1]. Many variations of such algorithms exist, and as machine learning learns to improve itself, these variations are formed to fit best to a certain problem and context. In management, and also in other contexts, a decision can be divided into two bases; a decision can be analytically-based or intuitive-based. An analytical approach often involves analyzing knowledge through conscious reasoning and logical deliberation [19]. Such an analytical decision is easier to be handled by AI, as this is a knowledge-based decision. Moreover, it requires logical consideration. As this approach is well-structured, an AI system would be able to perform in a good manner. On the other hand, an intuitive-based decision is harder to perform for an algorithm.

Intuition, in a decision-making context, is defined as a capacity for generating direct knowledge or understanding and arriving at a decision without relying on rational thought or logical inference ([38] as cited in [19]). Thus, if an algorithm would have to make an intuitive-based decision, it would have no or little prior knowledge of the specific situation, and could not perform any logical reasoning. As logical reasoning is at the basis of algorithmic decision-making, as of now it is still very difficult for an algorithm to perform such a task.

Therefore, even though AI-based decision-making can be used in companies, this should go hand in hand with a human manager who makes intuitive and last-minute decisions. One approach that is particularly relevant to gauging the rate of future automation is the “learning apprentice” (sometimes called the “human in the loop”) approach, in which the artificial intelligence program acts as an apprentice to assist the human worker, while also learning by observing the human’s decisions and capturing these as additional training examples [5]. In this way, the AI can perform most of the analytical decision-making, whereas the human performs the intuitive decision-making. Next to this, as the AI is also learning from the decisions a human makes, it might evolve in becoming more intuitive-based. In this way, over time the AI will be able to make more decisions and take over more decision-based tasks from the human manager.

Nevertheless, before this can develop, the AI system will have quite some uncertainty, as it is supposed to learn from itself. Uncertainty is characterized as a lack of information about all alternatives or their consequences, which makes interpreting a situation and making a decision more difficult ([8] as cited in [19]). This uncertainty can be seen as a reason not to implement an AI decision-based system, nevertheless such an investment should be seen as a long-term investment, as the AI system will perform better over time. A test-and-learn mentality will reframe mistakes as a source of discoveries, reducing the fear of failure [14]. Thus, the mentality of the employees of a company should be open and accepting of mistakes, as the AI can not be expected to perform perfectly at the beginning. Then, after it has had time to run, the algorithm will be able to encompass human efforts, and thus might even be able to replace the human in the loop fully. Nevertheless, it is uncertain whether AI will be able to perform the intuitive and creative part of a managerial function. The realistic implementation of AI-based decision-making, for now, is an AI assistant working with a manager. One way to materialize the synergistic relationship between AI and humans is to combine the speed of AI in collecting and analyzing information with humans’ superior intuitive judgment and insight [19].

4.3 Algorithmic Management

A movement in the digitization of management within companies is algorithmic management. In algorithmic management, computers do not facilitate governance (as in evidence-based management), but instead, governance itself is made obsolete through total control provided by data ([45] as cited in [39]). In this case, human managers are fully replaced by computers. Within algorithmic management, there is a shift of power. This algorithmic management, or Scientific Management 2.0, if you wish, shifts power from a hierarchy of managers to larger cadres of professionals who master analytics, programming, and business [39]. This means algorithmic management is still managed by humans, but these people control and observe the algorithmic management instead of managing themselves. This type of management is not applicable in every company. Algorithmic management practices are often applied in the context of freelancing or “quasi-employment” on digital platforms ([7] as cited in [32]). Thus, it is applied mostly within the gig economy, where companies have employees working for certain projects or for a certain period of time. An example of where this is applied is Uber, where the people working at Uber are freelancers. These freelancers are constantly observed and controlled by algorithmic management. Algorithmic management is characterized by continuously tracking and evaluating worker behavior and performance, as well as automatic implementation of algorithmic decisions [32]. Uber has many people all over the world working for them. By using algorithmic management, Uber can control and observe all these employees, as the AI system used in this management can handle all these employees at the same time. Human management would not be able to do this. Thus, because of algorithmic management, Uber has had the chance to grow into a large international enterprise.

Algorithmic management is built on a constant stream of information regarding individual workers’ behavior in any given situation ([36] as cited in [32]). Because of this constant stream of information, the algorithms used are able to adapt and make personalized decisions based on each employee. These decisions include a personal evaluation for each employee. For example with Uber, customers of drivers can give a review on the app, and this is immediately given back as feedback to the driver by the system. In this way, if a driver receives more positive feedback, it will come forward as a pleasant driver, and thus more people will want to travel with this driver. Such a feedback system is all controlled by algorithmic management, and this system thus has effects on the way employees behave. Algorithmic management and computer augmented transparency are not only shaping the objective conditions of workers, but they will also inevitably shape the identities of employees – the way members of an organization conceive themselves and their work [39].

This can have a positive effect, for example if drivers see they have a bad review, they might change their behavior accordingly. On the other hand, a negative effect is that employees feel they should change their identity because the system says so. Moreover, even though a positive aspect of having so many employees as Uber has is the diversity, this diversity could decrease because of the feedback of algorithmic management.

A characteristic of algorithmic management is transparency. As algorithmic management consists of a rule-based system, it has high transparency. An algorithm that adheres to a generally accepted and justified set of rules can actually increase the transparency of decision making and management ([17] as cited in [32]). Because the management consists of a set of rules, the management is built up in a structured form, and therefore it is very transparent. Next to this, because no human managers are involved, emotions and subjective opinions won't influence management and thus there will not be a bias towards certain employees. On the other hand, algorithmic management can in a way cause low transparency. Companies are rarely motivated to disclose the underpinning criteria of their algorithms and are sometimes unable to fully explain the results themselves, creating very low transparency for those managed by the algorithms [32]. However, if the companies are trained to understand the algorithms, and access is given to employees to review the algorithms and ask questions about them, this problem can for the most part be avoided. Right now, as the implementation of AI is fairly new within management, practical investments of providing a thorough understanding of AI systems in this setting are still things to be discovered.

Even though it might seem like a good development to use Artificial Intelligence within companies, it is important to note that this is not efficient if the employees working with it do not comprehend the systems they are using. Therefore, in many cases, domain experts such as data scientists are brought to a company to support the technological change. Given the scarcity of cognitive technology talent, most organizations should establish a pool of resources —perhaps in a centralized function such as IT or strategy— and make experts available to high-priority projects throughout the organization [10]. By doing this, the implementation of new systems is beneficial, whereas otherwise it would take more effort than that it enhances efficiency. Another aspect involved with this is that employees should be open to the idea of working hand in hand with AI systems. Even though Artificial Intelligence is used more and more in daily life, many people still prefer working with what they know. In this case, this means employees would prefer working with other human employees. Nevertheless, with the proper training and education, employees can develop a new way of working if this is encouraged within a company.

Chapter 5

Trust and Effectiveness

Although it might seem efficient to implement Artificial Intelligence within management, this is only true if the people working with such a system cooperate with it. As described in Chapter 4, if people do not comprehend a new implemented system, it will not be useful within an organization. Nonetheless, this can be resolved by bringing experts of the field to the organization to help train employees and help them develop their understanding.

Another concern regarding the implementation of Artificial Intelligence, in general, is trust and fairness. In the case of management and AI, this is especially a great concern. For instance, consider a situation where an AI-based decision-making system is used in an organization, and based on the decisions made by this system, the employees perform some kind of action. If we would take AI out of the equation, the decision would come from a manager, and based on the manager's opinion the employees would follow this choice. But when bringing AI back into this picture, the employees have to follow the decisions made by the system. An employee can have the feeling not to trust this system. This can for example come from a lack of comprehension or a lack of relation to this system. If the employee decides not to follow the choices made by the system, based on the lack of trust, and this employee will not perform a task because of it, this could be of great influence on the efficiency and productivity of an organization. In the worst-case scenario, this could lead to a deficiency in the production process and it could be causing a great setback for the organization.

Such a situation is a good example to show why trust in a system is crucial for it to be efficient. To find a way to build trust, it is important to see where the initial lack of trust comes from. Most people do not trust a system even before it has had time to prove itself. Other research suggests that people trust their own judgment more, especially after the algorithm has erred, probably because they believe algorithms cannot learn from their mistakes ([11] as cited in [24]). Figuring out why this happens could be part of the solution to eliminate the lack of trust.

Trust can be defined as the attitude that an agent will help achieve an individual’s goals in a situation characterized by uncertainty and vulnerability [24]. With automation technology, it is important to define the right level of trust, where employees rely on the machines’ capabilities and accuracy. Research has shown that some people trust algorithmic decisions more than human decisions. To gather what is needed to build trust in management and AI, I created a conceptual analysis of trust. This conceptual analysis consists of four different concepts all associated with trust, namely judgment, People Analytics, fairness, and emotional relation. These concepts are defined in the sections below to see where the concerns lie regarding the use of AI in management. The figure below, 5.1, shows the conceptual framework of the analysis.

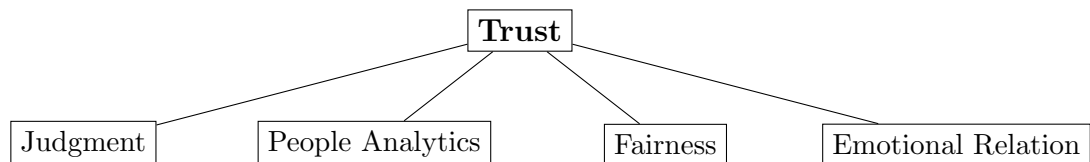


Figure 5.1: Conceptual framework of trust

5.1 Judgment

In general, people will rely more on judgment made by close friends and family, than on the judgment of strangers. Therefore, it might seem logical to think that employees rely more on judgment made by their coworkers than judgment made by algorithmic management. On the other hand, work in computer science shows that participants considering logic problems agreed more with the same argument when it came from an “expert system” than when it came from a “human” ([12] as cited in [26]).

To see which kind of judgment employees would rely more on, Logg et al. performed a study on this and the results are described in their paper “Algorithm appreciation: People prefer algorithmic to human judgment” [26]. In this study, people’s reaction to advice from an algorithmic advisor was compared to the advice of a human advisor. Different experiment settings were used. Overall, the results showed that people relied more on algorithmic advice than on human advice. For instance, in one experiment, people appreciated the algorithmic decision over the human decision, even though there was little explanation about the algorithm.

Another experiment showed some participants even relied more on the algorithmic judgment than on their own judgment. Even when predicting interpersonal attraction, a domain where individual preferences (and emotions) rule, participants relied more on identical advice when they thought it came from an algorithm than when they thought it came from other people [26]. All of these results show that people rely more on advice from an algorithm than from a human. This is in contrast with what most research suggests as it states that people have an aversion to algorithmic judgment. Algorithmic aversion refers to people holding negative perceptions about the recommendations and decisions made by algorithms, regardless of the content quality, relative to those made by other people ([20] as cited in [42]). However, this study shows that in certain environments this does not happen. Thus, there is room to improve the direction of algorithmic aversion to algorithmic appreciation. This can have a positive effect on the trust of employees in automated machines guiding their decisions. Although this finding seems to resolve the issue of a lack of trust in machines, in general most people still favor a human decision over an algorithmic decision in regards to management.

5.2 People Analytics

A characteristic of algorithmic management is People Analytics (PA). PA refers to computational techniques that leverage digital data from multiple organizational areas to reflect different facets of members' behavior [16]. Utilizing algorithmic technologies, PA analyzes these data for patterns and present decision-makers with more granular views of organizational resources, processes, people, and their performance ([18] as cited in [16]). Thus, PA gives an organization insight into their employees' behavior within that organization, and also on particular processes within an organization. Because of what PA does, it can cause many ethical concerns for the employees that PA is used on. PA relies on an algorithmic analysis of large quantities of data to facilitate evidence-based, objective decisions that are meant to make organizations more transparent, fair, efficient, and productive ([31] as cited in [16]). However, if the usage of PA itself is not explained and visualized well, this can be in contrast with the transparency and fairness that PA is supposed to provide. Therefore, it is important to consider when using PA, to make the data that is used transparent. Next to this, of great essence is to explain the underlying processes involved with PA. However, explaining the algorithms used might be difficult, as there are complex processes involved with the development of such an algorithm. Moreover, providing too much transparency about the algorithms can be overwhelming for employees, as they have much information to comprehend.

Therefore, the right balance should be searched for, such that employees feel like they have access to enough visibility but they won't feel overwhelmed by it. If this right balance is ensured, employees will develop trust in such a system. Thus, to make the usability of PA available for organizations, the transparency and in turn visibility of PA should be made clear.

5.3 Fairness

To ensure trust within an organization, another concept to consider is the perceived fairness of employees towards machines. Fairness is defined as treating everyone equally or equitably based on people's performance or needs ([25] as cited in [24]). Considering automated machines, this entails being treated equally by a machine, including the expectation of being treated a certain way. If one might feel as being treated unfairly, this could lead to feeling demotivated, which in turn could lead to lower productivity. Moreover, unfair treatment could lead to less affective commitment. Affective commitment is associated with how much employees want to remain with an organization, as distinct from their need to do so ([2] as cited in [34]). Therefore, this is an important aspect to ensure efficiency. People perceive decision-making procedures as fairer when they are (1) consistent, (2) based on accurate information, and (3) free of influence from the personal biases of decision makers ([4], [25] as cited in [34]). Thus, if these characteristics are met by a machine, people will perceive this machine as fair and more trust can evolve from this fairness.

The first characteristic of consistency is of importance. For instance, if two employees have worked on a project together, and delivered the same amount of effort, but one receives positive feedback and the other negative feedback without a valid reason, this can cause tension between the employees and towards the feedback system. This would be due to its inconsistency. The second characteristic indicates not only that information should be accurate, but also complete. For example, if an employee receives negative feedback about its functionality in an organization, this person wants to know where this feedback is based on to be able to improve. If a feedback system would only give feedback but without reason, this could lead to a negative relation between the human and the machine. Previous research on source bias suggests that attitudes towards an information source can influence judgments of the credibility and quality of the information ([41] as cited in [24]). Therefore, the third characteristic of fairness is important to ensure trust in a system. If a machine is free of bias it is more prone to consist of accurate information, as it will only contain factual data, instead of also consisting of data based on personal preferences.

Empirical research has shown that the removal of bias is particularly important to procedural fairness in formal, business-like situations ([3] as cited in [34]). If a system shows bias towards a certain opinion or group of employees, this could lead to other employees feeling left out and feeling treated unfairly. This will result in segregation of groups within a company, but also incoherent trust in the system. This can affect the productivity of the employees, and lead to serious issues regarding the development of the company. Therefore, if humans and their biases are removed from the decision-making process, this could improve employees' perceptions of the fairness of the decision-making procedures and bolster overall procedural justice ([25] as cited in [34]). Removing bias from the decision-making process is automatically done when implementing computational systems. Whereas human decision-makers are prone to judgment errors due to biases derived from intuition and other heuristics, algorithms can reduce, or even eliminate, such biases by relying on mathematical logic that converts various considerations (both quantitative and qualitative) into numerical factors [34]. Nevertheless, machine learning implies that such a system will learn to perform better over time by using its knowledge based on data. But if this data inherently moves towards some bias, the system will pick up on this bias unintentionally. Consequently, this will lead to the supposedly unbiased system being biased. Therefore it is important to ensure input data being free of bias. If this is controlled, a computational system could actually remove the bias, better than a human decision-maker could.

5.4 Emotional Relation

Another concept of trust defined in this conceptual analysis is the emotional relationship between humans or between a human and a machine. When an Artificial Intelligence-based system is used in an organization, employees may feel less connected to such a system than if it would be a human manager. This can result in the employees having less of a relation with the system, and therefore having less trust. Making subjective and intuitive judgments, understanding and expressing emotion, and navigating social nuances are still regarded as difficult for computers and machines to carry out, despite active research efforts to equip computers with such capabilities [24]. Due to this difficulty, a machine will not feel as supportive to employees as a manager would, and there is a lack of emotion. This lack of emotion is caused by a lack of intentionality towards a machine which consequently results in less affective commitment. Less affective commitment can cause an employee to feel like there is a substantial gap between that employee and the company.

Another aspect following this issue is datafication of the workplace. In datafied organizations, members are not treated as fully-fleshed, subjective beings. Instead, they are reconstituted and known as collections of objective digital data that they produce actively and passively as they go about their work ([9] as cited in [16]). Due to datafication, employees are classified into certain categories and based on their data a decision is made for them what position they take in an organization. This can cause issues regarding the identification of these employees. They might feel that their identity is being decided for them, and they can feel like they are not able to develop their own identities. This contributes to less affective commitment to a company as well. This issue can be broadened if the systems also identify certain groups or groups of behaviors within companies. Then, not only the identities of individuals but also the identities of groups of persons are decided on. In highly datafied organizations, human interactions are mediated, regulated, and at times controlled by algorithmic technologies [16]. All these aspects of datafication can cause employees to fully distrust the organizational department of a company and can cause employees to be unwilling to work for that company.

Datafication regulates many processes within a company and controls the activities and productivity, which could be beneficial. However, if a company would implement datafication, they need to ensure the freedom of expression and identity of their employees. If this would not be regulated, it can lead to many employees distrusting the company as a whole, and wanting them to transfer to another company. Moreover, datafication raises many ethical concerns, as it can create a hostile environment within a company.

Chapter 6

Case Study

To extend my research and develop a more in-depth view of my research question I performed a case study on the subject of AI in management. A case study is a detailed study of a specific subject, such as a person, group, place, event, organization, or phenomenon [30]. For this case study, I asked several questions to an expert in the field of management. I did this to gain more insight on the topic of implementing AI in management. This is an extension to this thesis, as there is only limited research that has already been done within this field. Therefore, by receiving an insight into what an expert in the field thinks of this subject, more information can be gathered as to how such a movement within management can or will be received.

6.1 Expert Interview

To perform this case study, I gathered questions regarding implementing Artificial Intelligence in management. I interviewed Dr. Y.G.T. van Rossenberg. Dr. van Rossenberg is an Assistant Professor in Strategic Human Resource Management at the Department of Business Administration of the Radboud University Nijmegen. She has also worked as an assistant professor at the School of Management at the University of Bath. Therefore, Dr. van Rossenberg has much prior knowledge about management and Human Resource management, and therefore can give her view on this topic thoroughly. Below, the full questions and corresponding answers can be found. The results are discussed briefly afterward.

1. *In which theory of management would you think the application of Artificial Intelligence could fit best?*

“This question can be interpreted in different ways.

- (a) I can see that management (as in people managing an organization) would like to draw on AI applications in doing their work. I can imagine decision making could be done on the basis of AI. There could be all kinds of positive effects, for example decisions based on AI could reduce personal bias (think about perception bias and personal preferences that are difficult to overcome). Decision making on the basis of AI would mean more advanced processing of options, more advanced than the human brain could do. Decision making on the basis of AI could be, and is likely to be superior to human decisions. On the other hand, management is about managing people and power. I can see that it would be attractive for managers to collect data and to draw on AI for making predictions about people, for example behavior, performance and sick leave. This may lead to all kinds of (un)ethical decisions, data protection. Questions should be asked if we should want such type of applications. In addition, leaving decisions to AI means less power to the management of an organization. Managers will be reluctant to do so. Why would you decide to make your job obsolete? The selection of a theory is dependent on which question you are looking to answer.
- (b) I can see that in research on management we can draw on AI. And then I cannot answer this question for the whole field of management since none of us in the faculty could answer this broad question for all different disciplines within the management field. It is dependent on what you are focusing on and what is your research question. In HR I see there could be interesting methodological applications which draw on AI (in other words: AI as a data analysis or research methodology).
- (c) I can see that in research in Human Resource Management AI could be used in the selection of employees, saving time and money and reducing human error in such. A study could then indicate the human preference, perception biases in this process. We did a study on perceptions of employability and found interesting self-other rating differences. Through AI we could (possibly) determine an “objective” norm for such perception based concepts.

Another interesting research would be perceptions of organisations drawing on AI in their company. How do employees view the use of

AI in their performance evaluations? Do they perceive it as (un)fair? (Un)ethical? Breach of privacy? Or do they actually prefer AI over decision making of managers who may have personal preferences / play politics?”

2. *Which characteristics of managing or parts of management would be good/fitted to be replaced by AI systems?*

“This is very difficult as management is about people and power.

- (a) Privacy issues: Collecting data to feed into AI systems is an ethical issue. Monitoring human behavior is and should be restricted.
- (b) Behaviour of people does not represent people completely and fairly. Once people know they are going to be monitored they will behave accordingly. This does not represent intentions, attitudes, and motivations. Humans are not robots and would not want to work in a place where they are treated as such.
- (c) Once AI supports decision making, managers will lose power. Managers will resist. What if AI tells them managers are not contributing to the productivity of the organization? Or more subtlety: what about AI informing a manager of an alternative he/ she does not prefer or suit?

I find it difficult to see applications of AI in management, I feel there will be a lot of resistance.”

3. *By collecting data faster, systems can make quicker decisions and solve problems more easily. Do you think this makes a company more efficient in this way or will the process of problem solving be too fast? Why?*

“This question is leading. I would rather argue that decisions are made faster by managers than a system could do... managers often decide in the spur of the moment, without carefully considering all options. A system that has been set up to make a decision will be slower, as the system will look for a systematic solution on the basis of complete information.”

4. *The social interaction between employees might decrease when making use of digital systems. Do you think this is a benefit or would this cause problems? Why?*

“Managers will resist the use of AI as it reduces their power. Being able to make a decision on the basis of “gut feeling” gives power. Drawing

on AI allows another manager to revoke a decision / to provide an “objective” calculation to go against decisions that are made by others.

On the other hand, employees may prefer (or not) decisions being informed by AI. Decisions (and considerations) should still be made by humans, and communicated by people to people.”

5. *In what kind of environment would an AI-based management work best? (Think of small start-ups or on the other hand big multinationals, with outsourcing, etc.)*

“This would probably work very well in unregulated young professions and in countries with a weak union / legislative system. . . Preying on the weak. Do consider collecting data from people for decision making always is an issue.”

6. *Do you think continuous monitoring of text and speech of employees will be beneficial or will cause problems? Why?*

“See above: here the argument of “what cannot be observed” is key. Lovely to calculate on the basis of speech or text, but this is in no way representative of intentions, motivation and attitudes. It gives an incentive for employees to behave in certain ways to play the system. Not productive nor a sustainable work environment.

Another consideration: Would you want to work in a context in which you know you speech and text is monitored? It is basically censoring: big brother is watching you!

If you monitor and thereby restrict behavior that also makes working more emotionally draining (remember deep acting / surface acting?).

Another thought: There are theories on creativity and innovation that show that restricting people’s freedom kills creativity.”

7. *Artificial Intelligence is also used in the recruitment process as a tool to select the right people for a function based on their data. Do you think recruiting people with AI is beneficial (because of its objectivity, no bias) or not (because of its lack of emotion, empathy, and subjectivity)? Why?*

“I feel it would be beneficial to do this as it avoids human preference. A selection process based on AI would be beneficial for all disadvantaged groups. People who would say it is not beneficial are likely to be of a group that currently is in a privileged position (white, male, middle-aged, western, higher educated, hetero sexual, able-bodied).

On the other hand, it would be very difficult to identify criteria that can be assessed using AI. Also, it would be difficult to agree on such criteria and the weighting. Then it would be difficult to inequivalently identify the extent to which people meet the criteria. But surely AI would come up with a solution for this.

Then, perhaps the most difficult, to convince people to use AI in the decisions process. Hiring is about power. Hiring a friend gives you power for next time a decision will be made. You hire people you like, who look alike (similarity-attraction), who you “owe” (your fraternity buddies), who you know (network), who you look up to (the “right” university) and people who speak your language (accent, class, gender). This is ALL about human preference, and not about a fair calculation. Using AI takes away power.”

8. *What do you think the future of management will look like, considering the influence of Artificial Intelligence?*

“Some ideas:

- (a) All people need to be able to do analysis of data to some extent. On the other hand, I hope managers will not be dazzled by numbers and advanced data analysis. Just because you can analyse data does not make you smart or you can press and sell your plans. Consultants often do this. Managers should always speak up against this type of consulting babble.
- (b) Research on AI in management in the selection process could potentially show the bias / subjectivity and discrimination. I’d love to do a (simulation) study to reveal this. Another one would be to identify promotion objectives and to judge the quality of the promotion assessment drawing on AI. Hint: at the moment the Radboud University is identifying new criteria for promotion for academic personnel. Lets see how well they can apply these criteria fairly!
- (c) Another interesting study would be the actual use of AI and resistance of managers against AI. Power is key here, afraid of losing power and losing their jobs!
- (d) Finally: we should study how monitoring influences employees. What type of unethical behaviors are you incentivizing by monitoring speech and text? This type of “side effects” / dark side of AI is very troublesome.”

6.1.1 Analysis of Interview

The first question (q. 1) asked is in which theory of management AI could best be applied. In Chapter 3, I applied AI to two specific theories of management. Nevertheless, I kept this question very broad intentionally, such that Dr. van Rossenberg could interpret it in her own way(s), as many different theories of management exist. Though this question is very general, the next questions dive deeper into the subject. The answer to this question consisted of different interpretations. One of these highlights the use of decision-making performed by AI. Dr. van Rossenberg mentions that different positive effects are coming from using such a system, such as reducing bias, more advanced processing, and that it could encompass human capabilities. Nevertheless, she also mentions that this use of AI as a power tool could come with many ethical concerns. In particular, if AI is used to make predictions about people and their behaviors based on their data, this could be problematic and this indicates managers have less power, as the AI is making the decisions.

Another interpretation of the question highlights the difficulty of this question, as it can not be answered for all different fields of management. She does mention that in the field of Human Resource Management, the application of AI could be interesting in the selection of employees, as it can save time and money, and can reduce human error. Through AI, an objective norm for perception-based concepts can be found.

Moreover, she mentions it could be interesting to research how employees would react to the implementation of AI in management, and if they would find it fair or ethically correct.

The second question (q. 2) still is formulated quite generally, as it asks what characteristics of management would be fitted to be replaced by AI systems. Dr. van Rossenberg answers that this is a very difficult question to answer, as management is about people and power. Therefore, implementing AI in management can raise privacy issues, as well as raise the problem that people's behavior might change when they know they are being monitored. People will adapt to the monitoring, and will not represent their own intentions and attitudes anymore. Moreover, managers will lose power when AI is implemented for decision-making. This will lead to managers resisting it, as an AI could tell a manager what and what not to do. Dr. van Rossenberg finds it difficult to imagine an application of AI in management because she thinks there will be a lot of resistance.

The next question (q. 3) refers to fast data collection of computational systems. This fast data collection will lead to quicker decision-making and problem-solving. The question is if this would make a company more efficient or if this would make problem-solving too fast. Unexpectedly, Dr. van Rossenberg mentions that she thinks decisions are made faster by human managers than by computational systems. The reason for this is the ability of human managers to quickly assess a situation and give a decision quickly when there is limited time. She mentions a system that has been set up to make decisions will be slower, as it will search for a systematic decision based on complete information. Therefore, a human manager would be quicker as it does not have to consider complete information.

The following question (q. 4) discusses the social interaction between employees within a company, and this interaction possibly decreasing when an AI system is brought into the management of a company. The question is if this is beneficial, or if it would cause problems. Dr. van Rossenberg mentions again that managers will resist to AI systems as it reduces their power. This power is based on being able to quickly make decisions when necessary. Using AI systems diminishes the effect of managers being able to solely make a decision, as others can now go against this decision because of AI. On another note, she mentions employees might prefer decisions being made by AI. However, she thinks decisions should still be made by humans, and communicated by people to other people.

In the next question (q. 5), I asked in what kind of environment AI-based management would work best. Dr. van Rossenberg answers that it would probably work very well in unregulated young professions, and for countries with a weak union or weak legislative system. She also mentions it should be considered that collecting data from people is always an issue.

The next question (q. 6) refers to a specific application of AI in management, namely the continuous monitoring of text and speech of employees, and if this would be beneficial or cause problems. Dr. van Rossenberg highlights that calculating based on speech and text is not representative of any intentions, motivations, and attitudes, and it, therefore, incentivizes employees to behave a certain way to manipulate the system. Therefore, it is not productive nor a sustainable work environment. She mentions continuous monitoring can be linked to censoring, as it restricts behavior. This could lead to the work being more emotionally draining. Lastly, she mentions that other theories on creativity and innovation show that restricting people's freedom kills creativity.

The following question (q. 7) handles another subject of using AI in business, namely recruitment. It suggests that AI can be used as a tool to select the fitting people for a function based on their data. The question is if recruiting people with the use of AI is beneficial or not, taking into account the objectivity of AI versus the lack of emotion of AI. Dr. van Rossenberg feels it is beneficial to use AI in recruitment, especially in the case of disadvantaged groups, and she says people who disagree with this use probably are in a privileged position. However, she mentions it is difficult to identify the criteria used, and therefore it would be difficult to identify if someone meets the criteria. Nevertheless, she thinks AI will be able to create a solution for this. As a last argument, she mentions it might be hard to convince people to use AI here, as hiring gives someone power. As recruitment is also about human preference, this is hard to implement with AI as this consists of fair calculations. Thus, using AI takes the power of human preference away.

The last question (q. 8) went back to a more general format. Here I asked what Dr. van Rossenberg thinks the future of management will look like, considering the influence of AI. She proposed a few ideas. One of these ideas is that in the future all people need to be able to do some sort of analysis of data. Nevertheless, she hopes managers will not be overwhelmed by all the analytics coming with this, and people should not feel like they can sell their plans just because of their data. Managers should always be able to speak up and notice such a trend. Another idea is that research on AI in recruitment could visualize the perceived bias and subjectivity. Next to this, research could identify promotion objectives and judge the quality of the promotion assessment drawing on AI. A following idea is to study the actual use of AI and resistance of managers who are against AI, focusing on losing power and the possible fear of managers losing their jobs. Lastly, Dr. van Rossenberg mentions a study should be performed on how monitoring influences employees, and what unethical behaviors are incentivized by monitoring.

6.2 Conclusions of the Interview

In Chapter 5, I focused on concepts influencing the trust in AI systems in management. However, as this chapter was about concerns around trust, I did not include the concern of loss of power of managers that Dr. van Rossenberg highlighted multiple times during the interview. I agree that this aspect of the implementation of AI is very important to consider as well, as it will influence the acceptance of AI within companies. For managers who first controlled their own environment, and then have to share this with a computational system, it can be a shock and they might feel like they are losing control. Moreover, this loss of control can also be magnified by the lack of trust in AI systems. In an even worse case, managers could resist cooperating with an AI system. Then, the implementation of AI will have more costs than not implementing it at first.

Another aspect that is not highlighted many times through this thesis is the effect of monitoring. I have discussed where monitoring could be used, and how this would work, but I have not provided much information on how this will affect an organization. As Dr. van Rossenberg mentions, monitoring employees can affect employees' behavior. Because employees are being monitored and they know they are being monitored, they might alter their behaviors to adapt to the monitoring. Considering the feedback systems based on monitoring, employees can decide to alter their behavior in such a way that they receive more positive feedback. This is also a concern of datafication of an organization, which is discussed in Chapter 5. Thus, monitoring can cause many ethical concerns, and the effects of monitoring should be controlled.

An interesting view Dr. van Rossenberg took on fast data collection by computational systems is that she thinks human managers are able to make a decision more quickly than AI systems. My intention of this question was that if the decisions are made very fast by AI, humans would not be able to keep up with the decision making, and therefore the process of dealing with issues would become slower and more inefficient. However, Dr. van Rossenberg thinks the opposite. I agree that in certain situations, it is important that a human manager can make a quick decision, even if the options have not been considered thoroughly. For intuitive-based decision-making, I agree that a human manager would outperform an AI system. Nevertheless, even though an AI decision-maker considers all data it has and makes a grounded decision based on this, because of its computational capacity, it still can be very fast. In that sense, it would be as fast as a human manager, and in the case of analytically-based decision-making even faster.

Regarding AI in recruitment, Dr. van Rossenberg thinks it is a good tool to reduce or remove the human bias that is present in this process. As mentioned in Chapter 5, research also supports this thought. On the other hand, replacing recruitment with AI systems will reduce the power managers have. I agree that the human preference in recruitment can feel like an advantage to managers, as if they hire someone, they will receive the credit for it. This built-up credit can in the future be beneficial for a manager in specific situations. I agree that this loss of power can be difficult to accept. Therefore, I think it would be most efficient to only implement AI systems in the first rounds of recruitment, such as CV- and background-checking, and keep humans in the loop for handling the interviews.

Chapter 7

Conclusions

Throughout this thesis, different applications of Artificial Intelligence in management have been discussed. In Chapter 3, the characteristics of both bureaucratic and scientific management were reviewed, to see where AI could be implemented. One of the main applications of AI that could be used in multiple characteristics of both theories is monitoring. Monitoring is important in order to fulfill multiple characteristics. In this way, part of these theories can be handled by AI. However, it is difficult to replace these theories as a whole, as nowadays these theories are not used fully anymore. Different aspects of these theories are still used by managers, but as these theories have been developed many years ago, in the meantime management has adapted a lot. However, another aspect of management that is mentioned multiple times within these theories is recruitment and the selection of employees. As discussed throughout this thesis, Artificial Intelligence can be used as a great tool to replace (part of) the process of recruitment. To conclude, this chapter gives an overview of the characteristics of the theories and gives implications for the use of AI within these theories, which opens a new window of exploratory research of AI in management.

Next, in Chapter 4, different applications of AI in management were discussed on a more general level. In this chapter, research that has already been done on implementations of AI was analyzed. This chapter shows that there are different options on how AI can be used in management. Although most of the papers discussed in this chapter do not solely use the systems that are designed for management, I think these systems are great incentives for how these can replace (a part of) management in the future. This chapter gives a good overview of the optional usages of AI in management.

When starting my research I hoped to find some papers that fully replaced management with AI. However, all papers that I found discuss the cooperation of an AI system with a human manager as a so-called human-AI symbiosis. Human-AI symbiosis means interactions between humans and AI can make both parties smarter over time [19]. Although some papers start with the thought of management being replaced by AI, all of these papers conclude this is still too far-fetched, and a cooperation of a system with a manager seems more optimal. Although I agree that for now a cooperation between the two parties seems more realistic, I think that in the future with more research, AI can take the upper hand, and the manager might only be needed to assist the AI system. By reviewing the applications that are already tested in Chapter 4, these can be used to develop an understanding of what is needed to get to fully using AI in management.

The next chapter, Chapter 5, discusses the importance of trust when considering AI in management. There are many ethical concerns regarding the use of AI in management. All of these concerns should be handled thoroughly before the use of AI in management is even possible. Next to these ethical concerns, without trust development in this field is impossible. A good foundation of trust should be built before anything else is being implemented, and this trust should continuously be evaluated and controlled. If this trust is lost at some point after implementation, the efficiency and effectiveness of such an implementation are reduced, and might turn out to be useless. This chapter provides a conceptual analysis on a new view of trust in management, and provides a good understanding of the concepts necessary for trust in management, with the use of AI. Moreover, when an AI system is being implemented, employees should be educated accordingly, such that they can work with the system, otherwise the effectiveness of such a system will not be enforced. Organizations should be prepared for a long-term transition when implementing a new system, as in the short-term the productivity of an organization will drop when the employees are learning to work with a new system.

In Chapter 6, the results of the case study are discussed. This case study has given an important view of what an expert in the field thinks of implementing AI in management. The case study has given new insights on other aspects important to this subject, and also has given different views on aspects discussed in this thesis. Dr. van Rossenberg is apprehensive about the implementation of AI in management, as it can come with many concerns. Nevertheless, she mentioned it is interesting to see where and how AI can be applied here. However, Dr. van Rossenberg does not see AI in management happening anytime soon, although in the field of Human Resource Management, there are more convincing applications of AI to reduce human bias, which can be used in the near future.

The research question of this thesis is: “To what extent can AI be used within the field of management, and to what extent do we want it to be used here?”. As this is a very broad question, it is difficult to answer. However, this thesis has taken a general view on this topic, so some implications can be made. As to what extent AI can be used within the field of management, I think there are many applications possible. As discussed in Chapter 4, feedback systems can be used to give feedback to employees instead of managers, and decision-based systems can be used to assist managers. Moreover, algorithmic management gives an insight into the application of AI in management as a whole. Nevertheless, algorithmic management is now only used for a few companies, as it can only be used in the gig economy. Even though I hoped to find a more broad application of AI in management, this is not possible for now. As there are many aspects concerned when changing management with AI, it will take many more years and development of new systems, before it is possible. Especially because management is involved with many people, and management is associated with many different concerns, it is difficult to say when and how this can be replaced fully by AI. Nonetheless, the applications discussed in this thesis show there is more than enough room for applying AI in management, and the cooperation between AI systems and managers is something that can already happen in the near future. I think this will enhance business in a way that it becomes more efficient, and thus the productivity of companies associated with AI in management will be greater.

The second part of the research question was to what extent we want AI to be used in management. This thesis gives a broad insight into the concerns associated with the implementation of AI in management. These concerns show that there is a lot to consider within this field. Nevertheless, as mentioned before, I think that if these concerns are considered and controlled, most of them can be prevented and resolved, and thus will not cause an issue for the implementation of AI in management. Nevertheless, I think these concerns can create a big obstacle for organizations to consider the implementation of AI and they weigh heavily for an organization’s productivity. The question is if you want management to be fully replaced by AI. I think the objective reasoning of management and everything associated with this is worth being replaced by AI. Also, tasks such as planning, organizing, and recruiting can be performed by AI. On the other hand, I do agree with other researchers that the subjective and intuition part of management is still to be performed better by human managers. Human managers encompass the emotional and ethical ability to react appropriately to a situation. Only if an AI is developed that can accomplish these abilities as well as a manager, it is possible to discuss the implementation of such an AI.

For the near future, an implementation that I think would work very well would be an AI system concerned with all the objective reasoning tasks of a manager, and a human manager concerned with all the subjective reasoning tasks. In this way, by using the AI system, a manager can give more time to the subjective tasks, which will allow for an improvement of the workplace environment and can lead to more efficiency.

To conclude, this thesis has given a good view of how and where AI can be used within management, and what the great concerns associated with this are. This thesis provides a new angle of view for this field of research, as it explores the implementation of AI in management theories and provides a conceptual analysis of trust in management and AI. By bringing the opinion of an expert in the field of management, better insight is given on the reaction of managers to the use of AI. This thesis is part of the first steps towards providing fundamental research on how AI and management can come together.

Chapter 8

Limitations and Future Work

As discussed in this thesis, only a few aspects of management are discussed in regard to applying Artificial Intelligence to them. This means there are limitations to this research. To be able to fully implement AI in management, all aspects of management have to be considered. This thesis focuses on the objective tasks of managers, such as decision making and providing feedback. Although this thesis gives a good view on how these tasks can be substituted, there are many other aspects still to be discussed in this matter.

As Dr. van Rossenberg mentioned in the case study, power and leadership are two important concepts of managing. Seeing how these two would fit in with AI has not been reviewed in this thesis. Both leadership and power are intriguing subjects to discover, as they both are defining in the use of AI in management. Therefore, what these concepts entail and what is needed to provide for them to implement AI in management is something important to consider in future work.

This thesis covers a review of what has been done in the field of AI in management and discusses what this means for the future of AI in management. This field of study is still very limited as not much research has been done. Therefore, it would be interesting to do more research on the implementation of AI in management. It is then important to research the reactions of employees in regard to the use of such a system. Moreover, as Dr. van Rossenberg mentioned, research on implementing monitoring AI systems within an organization can give insights into the (change of) behaviors of employees. The question then is if the behaviors of employees change due to the use of monitoring, and what this does to the work environment. What happens to the work environment is also interesting to see in regard to datafication of the workplace. Here research can be done on what digitization of the workplace means for the ambiance of an organization, and if this makes employees feel like non-human objects, instead of them being able to develop their own identity.

In future work, the ethical concerns regarding the implementation of AI should not be forgotten, as this can make or break the use of a system. Research in this field can give more insights on the actual effects of issues regarding AI in management. By extending research on this subject, the implementation of AI in management will become more realistic, as of right now this still seems far away.

In this thesis, a case study was performed concerning one expert in the field of management. This study can be expanded to more experts in the field, to get a broader view of the reactions of experts to this development. This can ensure a better understanding of their view on this matter. It can lead to providing a broader view of where AI stands within management.

To conclude, as only little research has been performed in this field, there is much more to explore and research. By doing more fundamental research, more opportunities will open up for the implementation of AI in management. This thesis has focused on providing a view of the developments in this field, and gives a new perspective of what is needed for the future of AI in management.

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