ALGORITHMIC MANAGEMENT & ALGORITHMIC LEADERSHIP: A SYSTEMATIC LITERATURE REVIEW

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ABSTRACT

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Abstract

Digitalization and automation technologies are transforming our lives, work dynamics and organizations. They give birth and enable totally new forms of organizational design – labor platforms, such as Uber, Wolt, Upwork and many other, - represent a new phenomenon, with a new managerial practice, in which the role of a human manager is diminished or non-existent. Over and above, both industry and research talk about potential of Artificial Intelligence to be part of the corporate board of organizations or even fully leading the course of their action. Some of these technology applications, like algorithmic leadership, are still yet to come, with many things to weight and consider before their implementation. At the same time, some have already been here as a real practice - algorithmic management – a system that is able to coordinate, monitor and organize workforce on its own, without human intervention. Due to these contemporary practices being topical at the moment and also, generally, fascinating to explore, this systematic review summarises the evidence of the present research done within the field. Its findings bring value for the advancement of research and for the industrial implementations of automation technologies for mediating management of the workforce. Among the main discoveries was the lack of communication in the work arrangement under algorithmic management, between all the parties involved – workers, organization and the system. A significant number of researchers in the field highlights the importance of social media usage, while some suggest that there is still a place, yet a different one, for human managers within these modern working structures.

Keywords

Management automation, leadership automation, algorithmic management, algorithmic leadership, corporate management, corporate communication, digitalization

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CONTENTS

1 INTRODUCTION 1
1.1 MOTIVATION FOR THE STUDY 2
1.1 RESEARCH QUESTIONS AND OBJECTIVE 2
1.2 THESIS STRUCTURE 3
2 BEFORE THE ALGORITHMIC 4
2.1 MANAGEMENT 4
2.1.1 Classical Management and Motivation Theories *4*
2.1.2 Management Functions and Roles *7*
2.2 LEADERSHIP 9
2.2.1 E-Leadership *10*
2.2.2 Shared or Distributed Leadership *11*
2.2.3 Substitutes for Leadership *13*
2.2.4 Leader-Member Exchange Theory *14*
3 METHODOLOGY 15
3.1 SYSTEMATIC LITERATURE REVIEW 15
3.2 SNOWBALL METHOD 21
4 STUDY PROCEDURE 22
4.1 PLANNING THE REVIEW 22
4.2 CONDUCTING THE REVIEW 25
4.3 REPORTING THE REVIEW 27
4.4 SNOWBALLING MATERIAL LINKING 41
5 RESULTS 43
5.1 MATERIAL DESCRIPTION 43
5.2 ALGORITHMIC LEADERSHIP AND MANAGEMENT 46
5.2.1 Algorithmic Leadership *47*
5.2.2 Algorithmic Management *50*
5.2.2 Critique of Algorithmic Management *62*
5.2.3 Communication and Motivation in Algorithmic Management *74*
6 DISCUSSION 78
6.1 ALGORITHMIC MANAGEMENT AND LEADERSHIP DEFINED 78
6.2 TRADITIONAL THEORIES & CONTEMPORARY CONCEPTS 80
6.3 ROLE OF COMMUNICATIONS 83
6.4 PRESENT PROBLEMS AND POSSIBLE RESOLUTIONS 84
6.5 LIMITATIONS OF THE REVIEW 85
7 CONCLUSION 86
REFERENCES 88

LIST OF TABLES AND FIGURES

FIGURE 1. Job attributes and their influence on workers satisfaction…….4
FIGURE 2. Dyadic relationships between leader and followers……....14
FIGURE 3. Stages and phases of SLR process……...19
FIGURE 4. The snowballing process…… 21
TABLE 1. Scoping study results…..…….23
TABLE 2. Search results per each database, keyword and stage of the SLR..……25-27
TABLE 3. Final set of selected material of the SLR process...……28-41
TABLE 4. The additional material resulting from the snowball method……42-43
FIGURE 5. The distribution of publication years within the review material…….44
FIGURE 6. The variety and frequency of research approaches in the field……..45
FIGURE 7. Terms encountered in the selected set of SLR literature ……46
TABLE 5. Articles that focus on algorithmic leadership……47
FIGURE 8. L-TAM model for technology acceptance in CH Leadership……49
TABLE 6. Articles that focus on algorithmic management……50-51
FIGURE 9. Types of work arrangements in gig work……..58
FIGURE 10. Perceived Organizational Support in algorithmic management……..61
TABLE 7. Articles that express critique of algorithmic management……63
TABLE 8. Articles on trust and transparency in algorithmic management……69-70
FIGURE 11. Trust at different representations and embodiments of AI……...71
TABLE 9. Articles on solutions to some problems of algorithmic management...…..72
TABLE 10. Articles on communication and motivation in algorithmic management……...75
APPENDIX 1**.** The flow chart of algorithmic leadership with human veto……94
APPENDIX 2. A circuits of power applied to algorithmic management……95

1 INTRODUCTION

Looking at the present, 21th, century, it is possible to observe many changes that have happened to traditional management in companies due to ever developing technologies. Till recently, these various technological tools have been used *by* human managers *to support* human managers in decision-making, controlling, supervising, planning and organizing through information systems and data collection across organization and beyond. This, however, is undergoing a radical change today. With the growing availability of Artificial Intelligence (AI) and automation technologies, computer systems are not here to just assist anymore. They are here to mediate middle management, through execution of control, supervision, workforce organization, task assignment, feedback and even motivation of employees (Mateescu & Nguyen, 2019; Derrick and Elson, 2019).

In his Forbes' review, McKendrick (2020) highlights the recent research discovery that, even though it was anticipated otherwise, managers are actually the ones, who are being replaced by technology, not labor workers. Supporting this statement, the industry can talk for itself. Fidler (2015) published a review of their successful experiment - an AI-power software prototype, which they called iCEO – a system, which is able to conduct and manage a complex project, where multiple parties need to be present. Resulting in a successful implementation, iCEO was able to coordinate and deliver a 124 pages research report on how graphene is produced. Among the system's responsibilities were the division of tasks, finding and hiring necessary contractors (through 3rd party online labor platforms) and quality assurance of the delivered results. Fidler (2015) reports, that there was no need for human intervention and that the project was completed in weeks, while normally this amount of work requires months, if done in a traditional manner.

The perceptions and attitudes of people towards this incremental change are quite insightful as well. In the study by Oracle and Future Workplace of 8,370 employees across United States, it has been discovered that people believe AI is better in providing unbiased information, maintaining work schedules and managing budget, among other more mechanical tasks, while a human manager is much better in creating and promoting corporate culture, supporting, understanding and coaching, as Schawbel (2019) reports. Opinions regarding the competence for some of the managerial functions, like problem-solving or team performance evaluation, had almost equal percentage of votes for both a human manager and its potential technological replacement. Thus, we can observe that the issue is controversial, and it cannot be said with certainty, which option is more plausible or effective for managing workforce.

With such discussions and practices taking place in the industry, it is intriguing to explore to what extent the academic side of the issue has developed and what it has to offer. Taking into account these trends, I believe, it is the right time to explore

present theoretical contributions and, possibly, to revise some of the traditional corporate management and leadership theories and approaches in this new, digitalized world we now live in. This work aims to contribute to this endeavor.

1.1 Motivation for the Study

To begin with, the automation of management is fascinating to study, mainly because at first it seemed that managers are the last professionals to be replaced by technology. The recent changes have proved that smart technologies can execute basic management functions very well and we can already see many examples of companies that function almost fully based on technology systems, which are the essence of their whole business, workforce gathering and coordination (e.g., Uber, Wolt, Amazon's MechanicalTurk, etc.). Looking at the academic side of the issue, this topic has recently drawn the attention of researchers as well, some of which conceptualized this automation practice of organizations like Uber as "algorithmic management", while others continued it further, introducing "algorithmic leadership" as something to come soon into businesses as well. Since these concepts are novel and emerging, it is not very clear yet what they mean exactly. Thus, I am interested to know how they are explained and, more precisely, what are the present researchers' perspectives and the degree of consistency between them, their definitions and conceptualizations.

Kaine and Josserand (2019) named "algorithmic management" to be a hot topic of both practitioners' and researchers' debate at this moment. Even though the interest of the scholars, in particular, is increasing, certain challenges have been faced in the field already (e.g., terminological and definitional ambiguities), due to the topic being interdisciplinary by nature and, as a consequence, having a variety of discipline-specific research perspectives (Jabagi et al., 2019). Thus, I deem it timely and important to provide an overview of the presently available literature on the topic, in order to demonstrate the state-of-the-art and to facilitate the formulation and establishment of this research area, limiting it to a reasonable extent and clarifying some of the uncertainties and misconceptions.

In conclusion, even though such systems as Uber have been in place for more than 10 years already, there is a lack of understanding on how these systems are designed and what it is like to work under their management. Besides, with the years, the number of online labor platforms is growing, and not only more mechanical, but also knowledge work slowly becomes platform-based (e.g., Upwork). The influence of management automation on different types of workers, along with its practical aspects and challenges is what I am determined to know more about through this review.

1.1 Research questions and objective

Even though most of the articles on the topic have been produced in the same period of time (80% of them in 2019 and 2020, see Figure 5, p. 44), their perspectives, use of terms and topic conceptualizations vary. Thus, this review aims to provide an integrative overview of the current research on the topic, which would focus specifically on algorithmic practice of leadership and management in academia at this very moment.

This study will gather and review the available knowledge on the topic of management and leadership processes led by algorithms or, in other words, on the automation of the two corporate practices. The results produced will demonstrate the existing research perspectives, present definitions and conceptualizations that have been introduced so far, their similarities and discrepancies, which should help to navigate further research and also to unite the researchers in the field. In a way, this review should aid in making the topic conceptualization process easier and more systematic, and guide it towards a uniform direction instead of scattered perspectives, as of now (presented in chapter 5.2.2).

The results of this review should bring clarity to the existing ambiguities and misconceptions, as well as to outline the scope of the topic (Palmatier et. al, 2018; Snyder, 2019). Then, benchmarking these findings on the existing human management and leadership theories should facilitate the conceptualization of the topic. The researchers in the field are starting to empathize and pointing out the importance of looking at the matters from conventional, established theories of leadership and management (e.g. Noponen, 2019, p. 48) to close the gap between algorithmic and human practices.

To specify the goal of this study, the main question is addressed: **what are the algorithmic management and algorithmic leadership practices**? To bring more details into the analysis of the review material and to produce more granular insights, several sub-questions have been specified as follows:

1. How algorithmic leadership and algorithmic management are defined? What other terms are used when talking about the same phenomenon?
2. What elements of the traditional human management and leadership theories are present in their algorithmic substitutes? *What is still same, what is different, what has been ignored and left behind?*
3. What are the challenges and problematic parts of algorithmic management and leadership? At what levels they have been identified? (e.g., ethical, employee) Are there any possible solutions or improvements to them?
4. What is the role of communications in these practices? *Are they perceived as a strategic asset?*

1.2 Thesis structure

This thesis is structured as follows. First, the background theories relevant to the studied topic are overviewed (Chapter 2). After that, Chapter 3 explains the

methodologies used for conducting the research and justifies their choice. In this chapter, the guidelines and structure of the systematic literature review is outlined, along with the description and guidelines of the other technique used for the data collection process (snowball method). Chapter 4 is dedicated to the presentation of the actual process of the review and its results. Chapter 5 reports the findings of the study. It is followed by Chapter 6, where they are discussed and reflected upon, where the answers to the research questions are provided, and the limitations of the study are outlined. The thesis is summarized with the final conclusion in Chapter 7.

2 BEFORE THE ALGORITHMIC

Because it is rather difficult to say where management ends and leadership begins (as leadership can be considered one of the management functions, while managing and supervision can be part of leadership practice), in this chapter there will be a tentative division of these theories, based on how they are separated in literature.

2.1 Management

As numerous studies reveal, the phenomenon of management being completely mediated by technology has already been a reality for some time. Thus, in order to understand its algorithmic form better, it is important to know what similar elements it has with the existing concepts of management, developed and executed by humans. I will start with the overview of some of the classical management theories, followed by the early theories of motivation and human relations and the new perspectives they have brought into management research, finishing with a more general perspective on management and leadership roles and functions, which has eventually formed based on prior research in the field.

2.1.1 Classical Management and Motivation Theories

Among early theoretical framings of management is the one done by Henri Fayol in the 19th century. It is known as **administrative theory**. In his work, Fayol outlined several key business activities, among which was managerial activity. More precisely, under this he considered a set of certain functions, which were: forecasting and planning, organizing, commanding, coordinating and controlling (Coal & Kelly, 2020, p. 33). These functions, however, were later revised (discussed in Chapter 2.1.2).

Fayol has also proposed 14 general principles of management: 1) Division of work (to distribute the effort and focus); 2) Authority (the right to give orders, which comes with responsibilities); 3) Discipline (accordance with agreements between organization and subordinates); 4) Unity of command (one worker – one superior); 5) Unity of direction (for the whole organization, as well as for each group of people and activities); 6) Subordination of individual interests to general interest (employees

should prioritize organizational interests over their own); 7) Remuneration (fair payment for commitment and in the context of external conditions); 8) Centralization (importance towards manager or, decentralization, towards subordinates); 9) Scalar chain (top-down hierarchy of authority); 10) Order (everything and everyone should know and be at their place at the right time); 11) Equity (treat everyone with justice and kindness); 12) Stability of tenure of personnel (giving personnel time to settle at a new workplace is important); 13) Initiative (should be encouraged within limits of authority); 14) Esprit de corps (organizational harmony and teamwork positively affect the performance) (Coal & Kelly, 2020, p. 34).

Scientific management is another famous theory of management. It was proposed by Frederick Winslow Taylor in 1911, who is also well-known for his interest in maximizing the efficiency of operations and productivity of labor (Coal & Kelly, 2020, p. 34). The main principle of the scientific approach to management is the revision of mentality and practice of both workers and managers. In order to achieve that, the following actions are deemed to be in place according to Taylor (1911):

- For each activity, process, operation a science should be developed, to replace any opinion-based rules.
- Based on the science and the nature of the job, a set of principles for conducting work on this job should be outlined (e.g. time and means needed). These scientific principles should also apply to managers, so everyone operates under a unified structure, and their cooperation with workers is encouraged (Thomson, 2003, p. 137).
- Workers selection should be done according to a scientific procedure, as well as their further training and development.
- The work should be distributed in the way of who performs better on which task, meaning that managers should take responsibility in what they are good at, leaving the workers to do their job and not overwhelm them with responsibilities (Thomson, 2003, p. 137).

Taylor believed that by studying thoroughly a certain job, then creating a science or norms that show a standard of how it should be done, on which also the payment should be based (e.i. those who are more efficient than the science postulates get a bigger pay and vice versa) is the true way to approach management and evaluation on the job. This way should prove beneficial for everyone, as a science should replace the possibility for bias towards the payment of workers and at the same time make the evaluation for the job easier for managers (Coal & Kelly, 2020, p. 36). Basically, in the algorithmic practice of management, algorithms can be perceived as serving as a "science", what makes this theory very compelling to reflect upon and, thus, it is quite often seen as a benchmark in literature on algorithmic management (see chapter 5.2.2).

Scientific theory has established the foundation for further progress in the field. Some, for instance, Henri Ford, took it as a lesson and used for its own production optimization, while some made more theoretical contributions, like Urwick and Brech (Uddin & Hossain, 2015; Coal & Kelly, 2020, pp. 37-39). There were, of course, those

who criticized Taylor's perspective and proposed alternative ways to treat workers, taking into account their personality and unique behavior, instead of a purely transactional and productivity-based approach (Uddin & Hossain, 2015). These are the representatives of the human relations school of behavioral scientists. With the social studies of Elton Mayo in the mid 1920's and Abraham Maslow's hierarchy of needs introduced in the 1940s, the focus of researchers was moved into a different direction towards human motivation at and for work gained the attention of researchers. Closer to the middle of the 20ths century, Douglas McGregor has proposed that there are two perceptions of workers by managers (Lawter et. al, 2015). He has called them **theory X and theory Y**. Theory X represented a more pessimistic perspective and implied management behavior similar to what Taylor proposed – supervision and control of workers is essential, because they are lazy by nature, prefer to avoid work and responsibility, and are not able to do any valuable intellectual contribution to an enterprise (Lawter et. al, 2015, p. 86). The opposite view, or theory Y, implied that workers can in fact enjoy their work, are capable of self-control and discipline, and might bring intellectual contributions to the operations and processes they perform (Lawter et. al, 2015, p. 86).

Another interesting theory of human motivation at work that might give a valuable insight into algorithmic management and help to distinguish the factors leading to a certain experience of workers is a theory of motivation hygiene or a **two-factor theory** by Frederick Herzberg. In his study, Herzberg's has identified and explored sixteen factors, which he was able to classify into two categories – those, which were highly reported as leading to satisfaction at work, and those, which were often linked to dissatisfaction (Weisberg & Dent, 2016). Figure 1 provides a visual overview of these factors and their relative distribution across two dimensions. It can be observed that such aspects of a workplace as company policy, supervision and working conditions have been often associated with the unfulfillment of employees. Salary, in fact, was also regarded as a rather dissatisfaction factor, while the responsibility proved the opposite. These findings of Herzbers should also help to understand better how such systems as, for example, Uber, use these elements in their system to motivate workers. For example, platform's gamification element can be seen as to create an achievement factor to motivate workers, which has proved to be the most powerful stimuli for motivation in Herzberg's study as well.

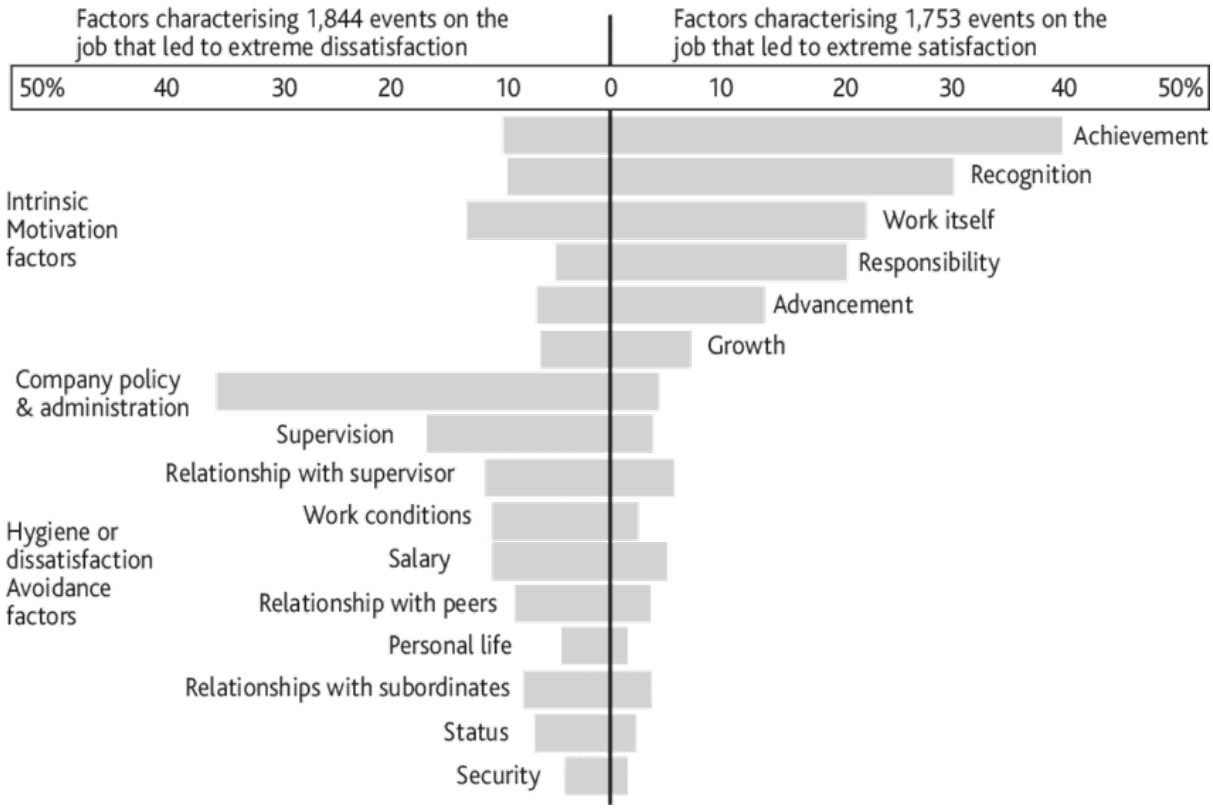


Figure 1. Job attributes and their influence on workers' satisfaction (Herzberg et al, 1959 as cited in Weisberg & Dent, 2016).

Even though in literature on algorithmic management Taylor's scientific management theory prevails in terms of mentions and comparisons with it, I believe that bringing other theories in light should help to analyze the phenomenon more comprehensively and to understand it better. For example, several principles of Fayol's administrative theory have been still present in algorithmic management, while some were omitted. Besides, there is evidence that supports both X and Y theories in the context of algorithmic practice (see chapter 5.2), but this connection has not been highlighted and noticed yet within the field. At the same time, two-factor theory could be useful in understanding the motivation of workers in algorithmic management, helping to identify the present factors in it that influence workers' satisfaction.

2.1.2 Management Functions and Roles

Taking a broader perspective, Koontz (1980, p. 183) has identified and summarized five managerial functions, based on his review of the existing management theories of that time. They were: planning, organizing, staffing, leading and controlling. ***Planning*** refers to the selection of organizational objectives and end goals, choosing the best means to achieve them, as well as setting the policies of conduct and defining the desired results (Coal & Kelly, 2020, p. 8). These activities can be long-term (e.g.

strategic 5-year plan) and short-term (daily, weekly, monthly planning, e.g. staff scheduling). Besides, the environment, in which organization operates, affects the choice of the appropriate planning components. The second function – ***organizing*** – is about identifying necessary actions to be taken to accomplish stated objectives, along with creating the structure of organizational roles needed for their execution. ***Staffing***, in turn, represents the process of assigning right people to fill these roles and supplying them with needed resources (Koontz 1980, p. 183). Communications are considered to be an important instrument for coordination and execution of organizational and staffing activities (Coal & Kelly, 2020, p. 9). ***Leading*** is also identified as one of the functions of management by Koontz (1980). It states for manager's actions to motivate workers, showing them how their contribution to the organizational goal matters and activating their intrinsic motivation to perform on a task (p. 183). The last function, ***controlling***, can refer to many organizational activities and has multiple definitions (Coal & Kelly, 2020, p. 375). A more general description is that it is a process of making sure the companies objectives are achieved by monitoring that the activities taking place are according to the plan and correcting them, when needed (Drudy, 2018 as cited in Coal & Kelly, 2020, p. 375; Koontz 1980, p. 183).

However these management functions were realistic, it was still unclear how management is different from leadership, until Kotter (1990) suggested the distinction of their functions. In his opinion, management as a phenomenon was a process dealing with complexity, while leadership was a process of coping with change. From this point of view, he considered ***planning and budgeting, organizing and staffing, controlling and problem-solving*** to be at the core of management, while ***setting the direction, aligning people, motivating and inspiring*** to be at the core of leadership (Kotter, 1990, p. 26).

Beside the purely functional approach to understanding these concepts, there was also the role approach, developed by Mintzberg in 1973 (Yukl, 2013, p. 29). Based on his study of practicing managers and the analysis of managerial characteristics, he has created a taxonomy of management roles, which consists of 10 roles in total, splitted into three categories: *decision-making* roles (entrepreneur, disturbance handler, resource allocator, negotiator), *information-processing* roles (disseminator, monitor, spokesperson) and *interpersonal* roles (liaison, figurehead, leader) (Coal & Kelly, 2020, p. 9).

Decisional roles. When acting as an *entrepreneur*, a manager takes initiative to drive a certain change, for instance, does something to improve the project, like acquiring new equipment or personnel. The role of *disturbance handler* is taken when there is a certain problem that needs resolution, like a conflict within a team or an emergency situation (Yukl, 2013, p. 30). A manager can use his authority, in order to obtain resources, such as money, equipment, facility, people and services. In this case he takes the role of *resource allocator*. In a *negotiator* role, a manager engages in

conversations with customers, employees, suppliers and any other external or internal parties on the matters of interest (e.g. contract negotiations).

Informational roles. A sufficient part of a manager's work consists of seeking, analyzing and operating with information, in order to identify problems and opportunities. This type of work refers to the *monitoring* role of a manager. Then this information can be, for example, *disseminated* to the subordinates. The third information role of a *spokesperson* relates to reporting and communication activities of lower or middle managers with their superiors and with the board of directors, in case of executive managers (Yukl, 2013, p. 30).

Interpersonal roles. One of the responsibilities of a manager is to ensure the functioning of a subunit as a part of the organization. In order to do that, it is sometimes essential to guide, support and motivate the subordinates. These activities put a manager into a *leading* role. Additional activities which Mintzberg considered to be ones of a leader were hiring, praising, rewarding, firing, training, criticising, promoting and dismissing the subordinates. *Liaison* role of a manager is about building relationships and networks inside and outside organization, primarily to have more sources of information. Finally, the *figurehead* role is more about formalities and legal duties, such as signing contracts and attending ceremonial events (Yukl, 2013, pp. 29-30).

In summary, clear outline of presently identified management functions is one of the keys to understanding the functions of algorithmic management, as well as its meaning and difference from algorithmic leadership. At the same time, knowing the existing management roles can bring more clarity to what is being the same and what is being transformed, when the practice becomes algorithmic. For instance, on Uber's example, some of the managerial roles like Liason (connects customers & workers, gathers external data to monitor situation) and Figurehead (to become an employer, it is enough to just register through the system) are present, but are rather reshaped and altered, compared to how they would look in the human practice. Overall, out of 10 manager roles, at least 5 can be observed in algorithmic management, while the rest of them is neglected (see chapter 6 for a detailed discussion).

2.2 Leadership

The definition of leadership appeared to be a big challenge to formulate (Stogdill, 1974 as cited in Northouse, 2016; Bennis, 1959 & Stogdill, 1974, as cited in Yukl, 2013, p. 18; Graen & Uhl-Bien, 1995). More difficulty to it was added because such terms as *administration, management, power, authority and supervision* have been frequently used in regards to similar phenomenon, what contributed to the ambiguity of the concept (Yukl, 2013). Nevertheless, a certain unifying aspect has been identified in most of the definitions. It was agreed that leadership can be viewed as a process in which the ***behavior of others*** is ***affected by the leader*** through execution of his ***influence***, with an

intent to navigate, structure, and facilitate activities and relationships, to advance strategic goals (Yukl, 2013, p. 2; Kessler, 2013, p. 809).

The researchers Harms and Han (2019), in their attempt to conceptualize "algorithmic leadership", named three elements, which they considered to be part of this phenomenon, which are the following: *e-leadership, distributed or shared leadership* and *substitutes for leadership* (Wesche & Sonderegger, 2019, also mention these elements as closely related to algorithmic leadership). In this subchapter, I will overview these concepts, their meaning and attributes, as well as other theories (e.g. on power and influence; reactive outcomes on execution of leadership) that, I believe, are closely related to and can help to analyze and understand better the algorithmic practice of management and leadership.

2.2.1 E-Leadership

Avolio, Kahai and Dodge (2000) were among the first to introduce, explain and advance the research development on e-leadership concept in the very beginning of the 21st century and technological era. They considered e-leadership to be a specific type of leadership, enabled by a certain context, where the Advanced Information Technology (AIT) provides leaders with means to obtain and control the information across organization (2000). The examples of such technology were e-mail systems, knowledge management systems, supply-chain management systems, enterprise resource planning systems and many others. In more recent articles, e-leadership is also referred to when the Information Communication Technologies (ICT) are in place, for example, in e-teaching (Wart et. al, 2017). Avioli et. al. made an important statement in their article that the context of e-leadership represents a part of it as a construct, so should not be studied separately, but together with it (2000, p. 616). Thus, in e-leadership, leaders are considered to have a huge impact on organizational performance, through their constant interaction with AIT, namely its design, creation and interpretation (what it can do and how it can be used to improve organizational performance) (Avioli et. al, 2000).

E-leadership can be defined as "*a social influence process mediated by AIT to produce a change in attitudes, feelings, thinking, behavior, and/or performance with individuals, groups, and/or organizations*" (Avioli et. al., 2000, p. 617). From this definition, it is possible to conclude that the leader and technology together form a system with specific behaviors, processes and interactions between the actors. When the context (e.i. type of technology) changes, these interactions and processes also change. In their updated review, researchers Avioli et. al. (2014) presented different levels of e-leadership evolution, based on the time periods of technological progress. At each of these levels, the interactions between technology, leaders and followers were different, due to the specifics of AIT platforms prior to each of the levels. For example, most recently, the use of AIT has led to "constant contact" of managers with

employees over mobile communication technologies, which have been often linked to higher stress, deficit of social attachment and lack of mutual understanding of the employees (Stokols et al., 2009). Such outcomes were named as dysfunctions of leadership (Avioli et. al., 2014, p. 119).

The potential mediation of leadership by technology in e-leadership is viewed from the perspective of robots leading human subordinates and is considered to be unlikely, but not entirely impossible (Avioli et. al., 2014, p. 117). The researchers note that even if the robots are developed to the point when they are able to recognize human emotions and psychological states, assigning them as leaders may possess threats, as robots themselves will most likely not have their own emotions, moral and ethical considerations, acting only from the plain directives embedded into them (2014, p. 117). Algorithmic leadership, in its turn, still remains to be a theory, rather than a reality, according to the present research and industry reports, but it can also possibly become an extension to e-leadership theory, as the research develops on the topic. Up till now, there has been only one attempt to connect them in the field.

2.2.2 Shared or Distributed Leadership

The second element of algorithmic leadership – shared or distributed leadership – is a form of team leadership, when there is no single formal leader in the whole team (only coach), but instead the leadership activities are distributed and shared between its members. This also includes the sharing of influence within a team, meaning that each member takes the lead when he or she has more situational expertise, but has to step aside and let others to lead when the situation changes (Northouse, 2016, p. 365). There are several reasons why shared leadership is considered to be more effective compared to a single formal leader guiding the team. One of them is that it is often challenging for a leader alone to execute all necessary leadership activities in the context of complex and ambiguous situations, while when shared, it can guarantee faster responses and, thus, higher effectiveness (Northouse, 2016, p. 365; Carson et. al, 2007). Another reason is that employees with great expertise, which are in high demand in knowledge-based work, usually prefer a higher degree of autonomy while they work, and are also seeking for the opportunity to lead when needed within their team. Lastly, the flatter organizational structure and self-managing teams popularity calls for the leadership to emerge inside the team (Carson et. al, 2007).

In distributed leadership, leadership is shared between the members. However, an external leader, coaching the team for greater effectiveness, should also be present (Carson et. al, 2007). Since algorithmic leadership mixes some elements of shared leadership, it is possible to assume that an AI-leader can be both within a team (assisting with, e.g., decision-making) or act as a coach, who can help the team in aligning activities for the task and in understanding the skills of each member, how to integrate them better and in what conditions (Hackman & Wageman, 2005). This

coaching can facilitate team members to engage in internal leadership activities (Carson et. al, 2007). With this in mind, in order to understand what could be the essential attributes of an algorithmic leader, it is important to know what are the necessary characteristics and activities of the team and its leader to be able to achieve excellence in performance. Larson & LaFasto (1989) have formulated eight following components that have to be present, in order for leadership practice to be effective (as cited in Northhouse, 2016, p. 369):

1. **Clear, elevating goal.** For the team to understand the performance objective of the task, its goal has to be clearly articulated. Moreover, the goal itself should be involving, so the team will stay focused on it, but its focus can be also ensured by an external leader.
2. **Results-driven structure.** Depending on the type of the team (top-management, emergency, tactical, advertising, etc.) their structure, including team roles, communication and individual performance assessment, should suit their specifics.
3. **Competent team members.** The right number of members with appropriate technical and interpersonal or teamwork skills has to be assorted for maximizing the performance effectiveness.
4. **Unified commitment.** The team spirit, engagement and the sense of unity within a team are important attributes of its excellence, and can be developed by involving all team members in each part of the process.
5. **Collaborative climate.** According to researchers, trusting relationships between members of the team create the atmosphere for collaboration. Besides, a focused team leader can also facilitate it through accurate execution of his or her control, demanding and rewarding collaborative behavior, ensuring the safeness of communication, and directing the problem-solving efforts of the team.
6. **Standards of excellence.** For the team to function effectively and for its members to act at their best, it is important that the performance is regulated by certain norms of conduct. The team leader has to clarify the expectations of the desired result, provide feedback to resolve issues and reward the exceptional performance (LaFasto & Larson, 2001, as cited in Northhouse, 2016, p. 371).
7. **External support and recognition.** Supplying the team with a support system of clear action path, data, information, training, rewards and other resources is essential for achieving the best outcomes from it (Hyatt and Ruddy, 1997, p. 582). Thus, organizational support plays a great role in team's excellence.
8. **Principle leadership.** According to Zaccaro (2001), leaders influence teams through cognitive, motivational, affective and coordination processes. By helping the team understand the problems needed to be solved, the leader executes cognitive influence over it. Formulation and setting of the team performance standards, along with the help to achieve them, demonstrates the

> motivational influence. The affective influence happens through clarification of goals, tasks and acting principles, which enable the team to deal with stressful situations. Coordination of the team is done through assigning the right people to right tasks, suggesting performance strategies, giving feedback and monitoring, as well as adjusting everything according to circumstances. Additionally, leadership itself should be also assessed for the healthier climate and team performance (Northhouse, 2016, p. 371).

The relevance and presence of these elements in algorithmic leadership will be explored based on the existing empirical studies in the field and discussed in Chapter 6.

2.2.3 Substitutes for Leadership

Substitutes-for-leadership theory postulates that a leader's behavior (or some of his/her functions) can be substituted for, neutralized or reinforced by situational factors (Kessler, 2013, p. 810). Among these factors are, for instance, the subordinates themselves (their knowledge, experience, amount of training, degree of autonomy needed, etc.), the nature of the task (its meaningfulness and intrinsic satisfaction it provides, degree of monotony and routine, feedback) and organizational characteristics (e.g. formalization degree, rules flexibility, amount of staff and support, etc.). Depending on the orientation of leadership, specific factors can affect it. For example, if the subordinate requires high independence on the task, has no interest in organizational rewards and has high expertise, this can neutralize both relationship-oriented or task-oriented leadership, as the leader-member relationship will be hard to construct in such case (Kessler, 2013, p. 810; Coal & Kelly, 2020, p. 61).

There are several categories of these situational factors. ***Substitutes*** are factors that decrease the influence of a leader over subordinates, and can eventually replace him. Technology is considered one of the factors that can substitute a leader or decrease the degree of his influence. Precisely, in a computer-integrated manufacturing environment, such things as quality control, productivity indexing, optimization directions are provided by a computer system and through the network communication technology an employee is able to easily contact other team members, tonexchange information and to respond to situations faster as a result. In this case, technology substitutes many managerial functions of leadership (supervision, control, etc.) (Howell et. al, 1990). The researchers note that in such cases for a leader to stay effective, it is necessary to provide guidance in such a way and form that is not available from elsewhere (e.g. motivating, engaging, encouraging). Another possible substitute factor is advanced training, when the leader has not enough competence and, thus, can not effectively lead, guide and supervise the subordinates (e.g. leader is an administrator, while his subordinate is a surgeon) (Kessler, 2013; Howell et. al, 1990). ***Neutralizers*** are factors, which prevent or counteract with a leader's actions and encumber his ability to make a difference. An example of such factors can be seen,

when a leader is separated from subordinates and communicates virtually, since many leadership techniques become ineffective. At the same time, when a leader loses control over the rewarding system, his ability to motivate employees becomes neutralized. Another situational example is when organizational hierarchy is neglected, for example, by a higher manager, who communicates directly to the subordinates, bypassing their middle-managers. In such a situation, middle-managers become "neutralized" in terms of their influence as leaders (Kessler, 2013, p. 811). ***Enhancers*** represent a different type of factors, as they can positively affect a leader's influence. For example, a leader's awareness and access to the information relevant to the project can enhance his influence over the project team. Additionally, relationship networks, both personal and within organization, are a possible magnifying factor of a leader's influence. Organizational culture, performance norms and ethical values can also positively impact the perception and followership of the leaders (Kessler, 2013, p. 811).

2.2.4 Leader-Member Exchange Theory

In Leader-Member Exchange (LMX) theory leadership is viewed as a process, which centers on interactions between leaders and followers. As many studies of algorithmic management do touch such topics as interactions and engagement between the workers and the system, it is important to know the present conceptualizations in human-human setting of the issue. During the early studies, this theory was called a vertical dyad linkage (VDL) theory, which viewed the exchange or relationship between the leader and followers as a series of vertical dyads (Figure 2).

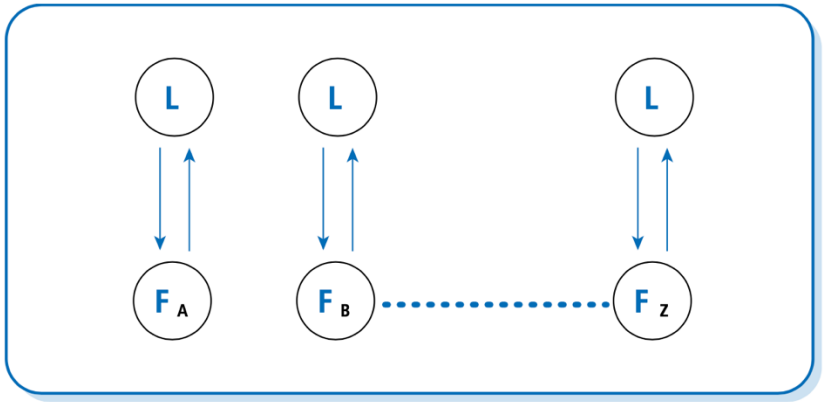


Figure 2. Dyadic relationships between leader and followers (Northouse, 2016, p. 139).

Eventually, two types of possible relationships (or linkages), each with certain characteristics, have been outlined: out-group and in-group. The former one represented those workers, who have a formal contract within an organization with fixed responsibilities, which they stick to, not willing to do anything extra or new. Their relationship with the leader is, thus, quite distant, with low exchanges of any

kind. On the contrary, the in-group incorporated those followers, who are willing to go beyond their prescribed responsibilities, asking the leader for more work. In return, they receive more information, influence and concern from the leader, are more communicative, engaged, but also more dependable on him. Basically, the in-group members do more for their leader and the same happens in return, making the exchange that happens between them richer and more meaningful. At the same time, the out-group members just come to work, do what they have to and then go home (Northouse, 2016, p. 140).

In later studies on LMX, the focus of research shifted towards the effects of leader-member exchanges on overall organizational effectiveness. During this period, the framework of leadership making was also proposed by Graen and Uhl-Bien (1995), which described leadership as a result of the process of constructing successful partnerships by the leader with all of his followers, by means of high-quality meaningful exchanges, in order to unite everyone to the in-group (Northouse, 2016, p. 142). When it comes to studying algorithmic management, such issues as employee turnover rates, commitment, attitudes and workers' perceptions of tasks assignment and evaluation are often raised. The researchers Graen and Uhl-Bien (1995) discovered that the quality of Leader-Member-Exchanges is positively correlated with these issues, meaning that valuable high-quality exchanges can lower employee's turnover, increase commitment, improve job attitude and promotion frequency. However, the presence, attention and support from the leader are the essential attributes for this exchange to be influential. Knowing the mechanisms of LMX, the algorithmic management practices can be more effectively studied – based on the present turnover rates and workers' experiences, it is possible to identify how exactly leader's (or system's) presence is lacking and which way it can be improved in further applications.

3 METHODOLOGY

For this study, the main chosen method is a Systematic Literature Review (SLR). An additional method to reinforce the selection of research material and to enlarge the coverage is a snowball method of references search. The selection of both methods is explained and justified in this chapter.

3.1 Systematic Literature Review

Literature review can be defined as a more or less systematic way of collecting available material on a particular research topic, in order to synthesize it (Snyder, 2019). It is argued that a well-conducted literature review can provide the firm foundation for advancing the knowledge in a research field and facilitate its development (Webster & Watson, 2002). The systematic literature review is a process of identifying and appraising a certain research, which is considered to be relevant for

the field, together with collecting and analyzing the available evidence on it (Liberati et al., 2009). The origin of systematic literature review methodology lies in the research field, different from business management and information systems. Thus, its usage in business research, despite all advantages, has not been very common, but is increasing since recently (Snyder, 2019). The justifications for choosing and adopting the method are presented below.

The researchers Bartunek, Bobko and Venkatraman (1993) have done a comprehensive study on the process of choosing an appropriate research methodology, especially if the method is adopted from another research field. They have outlined three main requirements that the method should fulfill, which are the following: significant methodological contributions, adequate conceptual grounding, and compliance with methodologically accurate strategies (Bartunek et. al, 1993, p.1363).

The first requirement is the need for significant methodological contributions the method should demonstrate. In other words, the researcher is expected to justify the choice of the method over the other possible ones through communicating the additional value it brings to the research field (Bartunek et al.,1993, p.1363). In management research, narrative or integrative literature reviews have been more commonly used, even though, as some researchers note, they lack in thoroughness and critical assessment, and may also possess researcher's bias (Mulrow, 1994, p. 598; Tranfield et. al, 2003; Snyder, 2019). Systematic literature review embodies a consistent, transparent, comprehensive analytical process of gathering the available evidence on the researched topic that is easy to follow and replicate (Siddaway et. al, 2018, p. 5). Additionally, Webster and Watson (2002) articulate that SLR can serve as an effective method for advancing knowledge and facilitating theory development in the new or emerging field. They also point out that interdisciplinarity of the studied field can make the process of constructing a review more complicated, since the theoretical information needs to be drawn from a range of different fields (2002). Nevertheless, a systematic literature review enables the integration of the available empirical conclusions and viewpoints and, thus, possesses a significant power of formulating the unified knowledge that no other research method can deliver (Snyder, 2019; Cumming, 2014). These attributes of SLR fulfill the first requirement of Bartunek et al. (1993).

The second requirement is the need for understanding the concept and scientific background of the chosen method (Bartunek et. al., 1993, p. 1364). According to the Cochrane Collaboration (http://www.cochrane.org/), which first has developed and described the procedure of the systematic literature review for medicine, SLR *"attempts to identify, appraise and synthesize all the empirical evidence that meets pre-specified eligibility criteria to answer a specific research question"* (The Cochrane Collaboration, 2020). Since the origin of systematic review lies in natural sciences, where it is used for bridging the gap between theory and practice, it is more structured and systematic and, thus, is considered to bring more reliability, replicability and

transparency to the research process (Cooper et. al, 2004; Tranfield et. al, 2003; Davis et. al, 2014). One of the main advantages of SLR is that it reduces personal bias of the reviewer. This has leveraged and facilitated its adoption in management and organizational research, especially because other types of reviews common in the field (e.g. narrative) were vulnerable in this regard (Mulrow, 1994; Tranfield et. al, 2003). Concluding the first two arguments, the systematic literature review has been chosen as a method for conducting this study, because the requirements of Bartunek et al. (1993) on selecting a research method have been fulfilled.

Systematic Literature Review (SLR) can be defined as "*a form of unstructured ontological discovery that provides detailed conceptual insights by shifting the level of analysis from authors and their citations to the actual words used by authors to provide a systematic, unbiased, and content-driven review of the literature*" (Kaine & Josserand, 2019). A decently carried systematic review can generate observation, evaluation, extension or development of theory, through linking the available evidence to theory and theory to evidence (Siddaway, 2018). Even though the quantitative analysis (or meta-analysis) of the material is a more commonly used approach in SLR, mainly due to its origin specifics, it is not always possible to apply this type of analysis to some research areas (Snyder, 2019). To tackle this problem, Grant and Booth (2009) have developed a method for analyzing qualitative studies in a systematic way, which is often referred to as a qualitative systematic review. In this approach, the process of the material collection follows a strict, transparent strategy, while the analysis is performed over the qualitative material and is aimed to integrate and compare the evidence, identify themes and constructs within it (2009, p. 94). Since in the research area on leadership and management automation the qualitative studies are prevailing (figure 6, p. 45), this review will follow the guidelines of the systematic material collection, while the qualitative approach will be utilized for data analysis and assessment.

The main objective of this review is to advance knowledge and facilitate theory development, since the algorithmic leadership, as an emerging study field, would benefit from such contribution (Webster & Watson, 2002). Among the main objectives of this review is to resolve definitional ambiguities and outline the scope of the topic; to provide an integrated, synthesized overview of the current state of knowledge; to describe research insights and existing gaps; to outline future research directions. For an emerging research field, like algorithmic leadership, these contributions are extremely important, as they can direct and facilitate the development of the research area v. The systematic process has been chosen as it adds value, compared to narrative or integrative literature reviews, through eliminating researcher's bias and the risk of random error (Moher et al., 2009).

One of the objectives of this review is to produce a thorough unbiased perspective of the present literature on the topic. This is the main reason for choosing a systematic approach. Moreover, since at present the narrative literature reviews prevailed in the field of algorithmic management and neighboring ones (as shown in figure 6, p. 45), I deem it important to provide a more objective viewpoint by means

of the SLR. These studies, which conducted narrative reviews and were identified within this review process, have not generally mentioned how they approached the process of the review (except a few) and how the selection of the material was performed. Thus, there is a threat of personal bias and lack of thoroughness within them, what can be perceived as a significant research gap in literature on algorithmic practices of management and leadership. This study addresses this gap and intends to narrow it at least to a certain extent.

Kaine and Josserand (2019) describe the algorithmic management phenomenon to be "among the most debated, in both academia and practice", highlighting the need for more work on the topic. The research area has not formed yet and its boundaries are not clear, what, for example, Sutherland and Jarrahi (2018) emphasize in their study by saying that "*there is not always agreement on these terms [e.g., algorithmic management], as researchers have different definitions of an 'algorithm' and some publications describe the technology as a platform, but only concern themselves with one algorithmic process of that platform.*" This review has also confirmed this assumption, as lots of different terms are have been used within the literature to address similar phenomena, without clear distinction between them (see Figure 7, p. 46). Jabagi et. al (2019) also characterized one of the research areas, which is close to (or can be even considered to be a part of) algorithmic management called "gig-economy", by "*definitional ambiguity and a variety of discipline-specific interpretations*" (presented and discussed in chapter 5.2.2). The aim of this review is to provide a complete and objective perspective on the topic of corporate leadership and management automation, its present conceptualizations, narratives and inconsistencies, in order to dispel the existing ambiguities and misconceptions.

According to many researchers, a systematic literature review is a process that should have clarity and a clearly defined structure (Tranfield et. al, 2003; Pittaway, 2011; Snyder, 2019). Tranfield et. al (2003) provides guidelines for conducting SLR in management research, where he divides the process into three major stages: (I) planning review, (II) conducting review, (III) reporting and dissemination. The coherent structure of the research process answers the final requirement of Bartunek et. al. (1993), which is that the chosen method has to follow specific, methodologically accepted strategies and guidelines of the chosen research method.

Each stage of SLR consists of several sub-steps or phases. The first (I) stage embodies three phases: identification of the need for a review (phase 0), preparation of a proposal for a review (phase 1) and development of a review protocol (phase 2) (Figure 3) (Tranfield et. al, 2003). At this stage of the process the researchers emphasize the need for a scoping study, which should help in assessing the literature in the field from size and relevancy perspectives, as well as in restricting the study area. A scoping study should provide an overview of the cross-disciplinary perspectives on the topic, alternative methods that were used for its research, and it might also include a short overview of the theoretical, practical and methodological discussion existing in the field (Tranfield et. al, 2003, p. 214-215). As an outcome of the first stage (I), the

researcher has to develop a comprehensive review protocol, specifying the research questions, targeted research material, search strategy, and the inclusion and exclusion criteria of literature. (tranfield et al note, however, that..) In management reviews, however, it is allowed to include just a conceptual discussion of the research problem and the argument for its significance, rather than a definitive research question (as in medical science). Additionally, the protocol may deviate along the way, with the explicit report on what has been modified and for what reasons. These indulgences are allowed in management reviews with a rationale to preserve researcher's creativity, while still keeping the process less open/subjected to bias (Tranfield et. al, 2003, p. 215).

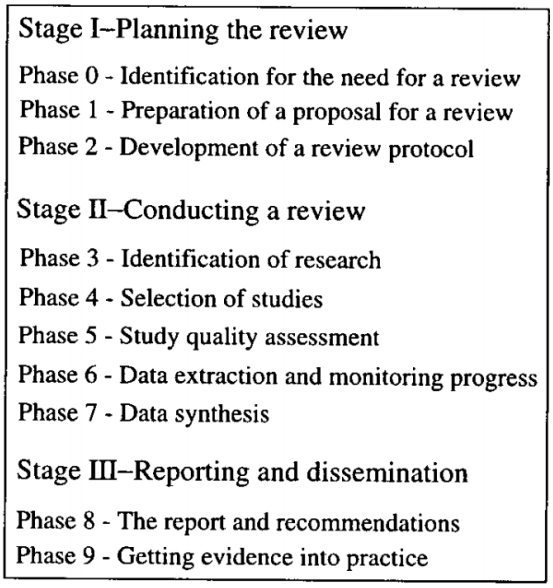


Figure 3. Stages and phases of SLR process (Tranfield et. al, 2003).

The second stage (II) is pivotal and contains five steps. It starts with identifying the relevant search terms or keywords that will be used in the final review process, based on the glimpse of literature found during the scoping study. The researchers also recommend to include conference proceedings, industry publications, as well as unpublished studies into the review, in order to broaden the outlook (Tranfield et. al, 2003, p. 216). During the selection of studies, a strict set of inclusion and exclusion criteria has to be introduced and most of the exclusion decisions reported. At this stage, quality assessment of the material should be also performed, before the data synthesis can be carried out.

The relevance of a study to the review is evaluated based on how relevant it is to the research questions. Quality assessment of the material should be performed according to the established criteria (Tranfield et. al, 2003). However, assessing the quality of a qualitative study holds a big challenge, as it is not possible to statistically evaluate the significance of findings. Greenhaigh and Taylor (1997, p. 741) describe the nature of qualitative research as not following strict standards and dependent on

researcher's and research subject's own experiences. Tranfield et al. (2003, p. 216) suggests the adoption of the following criteria developed by Popay et. al (1998, p. 36) to be used for assessing the quality of qualitative research material and guiding the inclusion and exclusion process of it:

- Is the aim of the study to investigate the subjective meaning behind the researched subjects in their actions and in specific contexts?
- Is research designed in a responsive way, to be able to tackle the possible changes during the course of the study?
- Has the chosen sampling strategy been developed in the best way and in accordance with theory to produce the necessary knowledge for understanding the issue?
- Are different sources and perspectives on the same issue benchmarked and reflected upon?
- Are the research process and methodology clearly articulated?
- If any generalizations are made, are they based on theoretical arguments or derived from logical conclusions?

In medical research, quantitative approach (meta-analysis) is normally used for synthesizing the evidence data, with the aim to generalize findings to the population through statistical evaluation (Tranfield et. al, 2003). In management, on the contrary, researchers are interested in understanding organizational processes rather than the effectiveness of a certain intervention, and may primarily perform a qualitative study of the issue (e.g in-depth interviews). Thus, a narrative approach for data synthesis in management reviews has usually been more popular (Tranfield et. al, 2003; Snyder, 2019). In order to find an alternative between overly comprehensive meta-analysis and generally considered to be open for bias narrative reviews, two interpretive methods – realist synthesis and meta-synthesis have been developed for systematic reviews in management research (Tranfield et. al, 2003). Both methods are striving to improve the traditional narrative reviews by adopting explicit and rigorous processes, and by *"bringing together findings on a chosen theme, the results of which should be to achieve a greater level of understanding and attain a level of conceptual or theoretical development beyond that achieved in any individual empirical study"* (Campbell et al., 2002, p. 2). The contribution of the review through these approaches can be achieved through informing the practice and policy-makers with accurate and understandable presentation of findings.

The final (III) stage of the systematic review process is dedicated to reporting the main findings. It can be, for example, themes found in literature and shared perspectives across these themes, as well as connections between them (Tranfield et. al, 2003). The main goal of this phase is to represent the gathered evidence in a clear and understandable way that can effectively inform the practice. It is also noted by Nowotny, Scott and Gibbons (2001) that for achieving a 'context sensitive' outcome of the review, the researcher may encourage practitioners to address the questions of

potential interest from the review and even engage them in the process. This, in turn, may strengthen the connection between science, policy and practice.

3.2 Snowball Method

According to Snyder (2019), systematic review as a research method possess a weakness, when it comes to studying broader topics, meaning those, which have been researched and conceptualized differently, from various disciplines' perspective. To tackle this weakness at least to some extent, the material gathering process has been extended through the snowball method. The snowball method was first developed as a technique for finding more research subjects for qualitative data collection. It worked on a principle that one person who took part in research provided the contact details of another person to the researcher, and then that person gave the name of the third one and so forth (Vogt, 1999). By using this approach, the researchers were able to access the so-called hidden or hard-to-reach populations, representatives of which are normally hard to locate (e.g. criminals) (Atkinson and Flint, 2001, p. 1). As the practical effectiveness of the methods was noticed, it has gained popularity and was widely adopted as a complementary method for systematic literature reviews (Wnuk & Garrepalli, 2018; Jalali & Wohlin, 2012).

In literature review research, articles are the studied subjects, and not individuals. Thus, in this type of research, each article provides access to other research material for the researcher, through its references and citations. Wohlin (2014) has developed specific guidelines for the snowballing procedure (Figure 4). These guidelines are followed during the search for literature in this study.

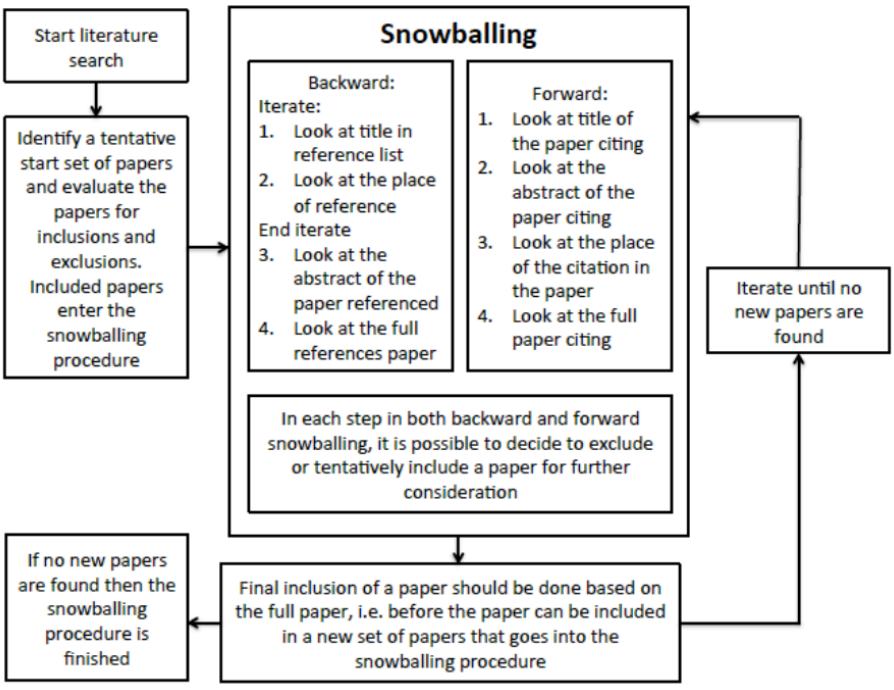


Figure 4. The snowballing process (Wohlin, 2014).

The process starts with identifying a tentative start set of papers. In the case of this study, the material obtained from the actual systematic review will be taken as the initial set of papers for the snowball method.

When the starting set is confirmed, the snowballing begins. One paper from the set is taken and examined at a time. The whole process consists of two parts – backward and forward. **In backward snowballing**, references of the paper are explored for finding new papers that are relevant for the topic and could be included in the review. In the reference list, title, publication venue and authors should be checked first. Then the abstract is read and, if needed, other parts of the paper examined, until a definitive decision is taken to either include or exclude it. **Forward snowballing**, on the other hand, explores the papers that cite the current paper. Each candidate citing the paper is reviewed. The basic initial analysis is normally done directly in Google Scholar, as it provides the citing information. If it is considered insufficient for a decision, the citing paper should be examined more closely. The rest of the approach of going through the papers is similar as in backward snowballing (Wohlin, 2014).

When backward and forward snowballing are completed on one paper, new papers that were identified during the iteration are gathered and prepared to be explored in the next iteration. The process continues till the point when no new relevant papers are found in the paper in focus.

4 STUDY PROCEDURE

4.1 Planning the Review

Before starting the review, the research area has been examined and the need for a systematic literature review was discovered. After that, the actual planning phase of the SLR process has begun. It was initiated by conducting a scoping study, which helped to get an overview of the field and of the presently available material, approximate the field size and locate the relevant literature, as suggested to be done by Tranfield et. al (2003).

For the scoping study, four databases – ProQuest ABI/INFORM, EBSCO Business Source Complete, Scopus and GoogleScholar – have been selected and random searches were done in each database. The reason behind testing several different databases was to avoid the algorithmic bias and content limitations of each specific database and also to obtain a larger set of material. Out of the four databases, only three (ProQuest, Scopus and GoogleScholar) were chosen to be part of the actual systematic search because they showed most results. The search terms *algorithmic leadership* and *algorithmic management* were used in the scoping study, as they cover

the research questions and the studied field well. The summary of the search results is presented in Table 1.

Database Name	**Algorithmic Leadership**	**Algorithmic Management**
Scopus	37	3,648
Google Scholar	35,300	440,000
Ebsco	4	133
ProQuest	8,719	35,752

Table 1. The amount of the search results for each term per database (scoping study).

The first observation to be made based on the scoping study is that the volume of the material on the topic is relatively small, with slightly over half a million results in total for two terms and four databases, with some results also overlapping across databases. The importance of selecting all possibly relevant and very specific search combinations is emphasized by Tranfield et. al. (2003).

During the scoping study, four key fundamental articles on the topic were found: "*Algorithmic Leadership: The Future is Now*" by Harms & Han (2019), "*When computers take the lead: The automation of leadership*" by Wesche & Sonderegger (2019) and "*Rise of the Machines: A Critical Consideration of Automated Leadership Decision Making in Organizations*" by Parry, Cohen & Bhattacharya (2019) and "*Big data and organizational design – the brave new world of algorithmic management and computer augmented transparency*" by Schildt (2016). These papers were considered to be central for the field, as they try to conceptualize the topic by viewing it in the light of human leadership theories and theories on human-computer interaction and technology acceptance. They have been also included in the final review material at this early stage already, because they contained the answers on some of the research questions addressed in this study.

Based on the content of these papers and stated research questions, the following list of keywords was formulated: *Algorithmic Leadership, Automated Leadership, Algorithmic labor* and *Algorithmic Management*. These search terms will be used in the systematic search in each of four databases, to eliminate the potential technical bias of search algorithms of one specific database. During the scoping study and test runs, other search terms (e.g. automation of management or AI in management) were used, but the obtained results were mostly irrelevant or highly intersecting with the ones obtained by the above mentioned four terms. As the scoping study has revealed, in some of the databases the amount of results is small and in some big. Due to the resources limitations of the study, it is impossible to process all the available material. In order to cover the sufficient amount of literature, it has been

decided to process the first 500 search results per term in each database. The empirical testings of reviewing the first 500 results and a sample of 400 results after the 500th hit were carried out. It was discovered that there are no relevant results for the search term and the study after the 500th search point.

Tranfield et al. (2003, p.215) and Kitchenham (2004, p.9) point out that SLR should include conference papers, industry trials, and unpublished studies and even internet articles in specific cases, beside the published journal articles. Among the reasons behind this suggestion was the possibility to extend the range of evidence and to have a more thorough perspective of the research area and publications' dynamics. Thus, conference papers and proceedings have been included into this systematic literature review. There was not much grey literature on the topic discovered, which could have been potentially insightful for the study, so it was decided not to include it in the review and analysis process eventually.

Beside the well-defined search terms, there should also be clear inclusion criteria for the material, as Tranfield et. al. (2003) note. According to the researchers, the inclusion process consists of multiple stages. Kitchenham (2004, p.10) provides guidelines on how to formulate the appropriate criteria for selecting the study material. It is emphasized that the initial inclusion criteria should be more liberal and further inclusion decisions more precise and specific, in accordance with research questions. Following the instructions by Kitchenham (2004), the following three-staged process of material selection was developed and used during the SLR process:

Stage 1: Consists of the inclusion criteria applied to the initial search material.

1. The first 500 search results are allocated (grey sources excluded, when possible). Since the exact subject of the topic is obscure, in order to allocate more relevant literature to the topic in this initial pool of articles, a filtering feature was used in some cases to eliminate the subject areas, which are highly irrelevant to the topic of interest (e.g. medicine, biology, etc.).
2. The article must be available in English language.

Stage 2: After the material is allocated from the initial search, the abstract of the publication is examined and should be relevant to the topic and study questions. The article is included, if the abstract provides answer to at least one of the following research questions:

1. Is algorithmic leadership and/or algorithmic management mentioned and defined? If not, does the article use other terms when talking about the same phenomenon?
2. What problems of algorithmic leadership and management are raised and discussed, if any?
3. How communications are developed in these algorithmic systems? Are they viewed as a strategic asset by organizations implementing the technology? Whom are they serving?

4. Does the article provide a linkage and/or benchmark with any established theories of management and leadership (or other ones, which?)?

Stage 3: At the final stage of the inclusion process the full article is read and the following inclusion criteria apply:

1. The article has to provide answers to several research questions. If it just relates to the topic, but does not provide valuable insights for the study and to its main objective, it should be excluded.
2. The quality of the article and the study should be representative (e.i. use of academic language, adequate usage of sources).

After all the articles have been reviewed and the final set has been formulated, the snowballing method is applied on each of the articles. During the snowballing procedure, the same inclusion criteria (stages 1-3) are executed on each discovered article (e.i. first it is collected based by name relevancy, then by abstract, then the full text).

4.2 Conducting the Review

In this subchapter, the second phase of the SLR is documented and presented. In this phase, the searchers with terms *algorithmic leadership, automated leadership, algorithmic management* and *algorithmic labor* in four selected databases have been carried out. Then the results filtering procedure was broken into the three-stages and the guidelines or requirements prior to each stage were applied to the search results, as described in the previous subchapter. Table 2 provides a structured demonstration of the whole review process and data collection at each stage.

ProQuest ABI/INFORM				
Search Term	Per keyword	Stage 1: The first 500 searches	Stage 2: Based on the abstract	Stage 3: Based on the content
algorithmic leadership	5,214*	500	15	1
automated leadership	76,202*	500	3	2
algorithmic management	38,523*	500	17	5
algorithmic labor	6,912*	500	47	9

ProQuest ABI/INFORM				
Search Term	Per keyword	Stage 1: The first 500 searches	Stage 2: Based on the abstract	Stage 3: Based on the content
Total	126,851	2000	82	17
Scopus				
algorithmic leadership	37	37	2	2
automated leadership	323	323	2	2
algorithmic management	1,753**	500	30	10
algorithmic labor	217	217	26	8
Total	2,330	1,077	60	22
Google Scholar				
algorithmic leadership	35,200	500	19	9
automated leadership	340,000	500	11	6
algorithmic management	445,000	500	22	5
algorithmic labor	60,100	500	12	4
Total	880,300	2000	61	23
EBSCO Business Source Elite				
algorithmic leadership	4	4	1	1
automated leadership	26	26	2	1
algorithmic management	133	133	19	10
algorithmic labor	13	13	6	1
Total	176	176	28	15

Total from all four databases	75
Excluding duplicates	37

Table 2. The amount of search results per each database and keyword at each stage of SLR process.

*Excluding: wire feeds, books, newspapers, blogs, podcasts and web-sites, historical newspapers, dissertations and theses, other sources and magazines. The exclusion of the sources is based on the Adams et. al (2016, p. 439) & Tranfield et. al (2003) suggestions.
**Excluding: medicine, material sciences, microbiology, nursing, chemistry, pharmatheutical, healthcare, physics, energy, mathematics, environmental sciences, veterinary.

After the final stage of material collection, a total of 75 articles have been identified from the four selected databases to be included in the review. The removal of duplicates has resulted in the number of 37 unique publications. The set of the final selections is presented in the following subchapter.

4.3 Reporting the Review

The final set of results from the systematic review process has been outlined in Table 3. In order to demonstrate the results in a more descriptive way and to set the agenda for the analysis and findings representation, the tentative answers to research questions each piece of the SLR material provides have been also presented in this table. For the ease of the reader, the following research questions have been guiding the selection and analysis of the material:

1. Is algorithmic leadership and/or algorithmic management mentioned and defined? If not, does the article use other terms when talking about the same phenomenon?
2. What are the challenges and problematic parts of algorithmic management and leadership? At what levels they have been identified? (e.g., ethical, employee) Are there any possible solutions or improvements to them?
3. What is the role of communications in these practices?
4. What elements of the traditional human management and leadership theories are present in their algorithmic substitutes?

№	Name, author, publisher, year	Main value for the review & research Qs	Closest or mentioned theories	Article's Keywords
1	*Algorithmic leadership: The future is now (P. D. Harms & G. Han, Journal Of Leadership Studies), 2019*	Provides clarification of AL & AM concepts, connection between them, short overview of the research field (Qs 1&2).	E-leadership, shared leadership, substitutes for leadership, leadership and management functions automation (Q1).	Leadership and Management Automation
2	*When computers take the lead: The automation of leadership (J. S. Wesche & A. Sonderegger, Computers in Human Behavior), 2019*	Aims to conceptualize algorithmic leadership, defines its elements and evaluation criteria, provides its potential acceptance criteria (Qs 1-3).	Mentions that future research should address the issue of which leadership functions should be automated (Q2).	Computer-Human Interaction, Leadership Automation, Technology Acceptance
3	*Is e-leadership development enlightening?: Handling fragmentation by making leadership algorithmic (A. Uhlin & L. Crevani, 35th EGOS Colloquium), 2019*	Discovered the problem of fragmentation in e-leadership and the opportunity of making e-leaderhsip practice algorithmic, where the source of leadership would be not human, but a technology or a computer (Q1).	How e-leadership practice has the potential to be transformed into being fully algorithmic, instead of having a human leader communicating through the technology (Q1).	E-leadership, Automation
4	*Rise of the machines: A critical consideration of automated leadership decision making*	The article explores the possible scenarios of the automation of corporate leadership decision-making. It implies what challenges there might	Corporate decision-making, transformational and transactional leadership and their characteristics, pres ent AI capabilities	Automated Decision-Making, Organizational Leadership, Artificial Intelligence

	in organizations (K. Parry, M. Cohen, S. Bhattacharya, Group & Organization Management), 2016	be in the integration strategy of such systems. The role of the human veto and the perceptions of the leader in different scenarios are discussed (Qs 3&4).	and their possible implications for corporate leadership automation (Qs 1&4).	
5	*"Technology-Mediated Control Legitimacy in the Gig Economy: Conceptualization and Nomological Network" (W. A. Cram & M. Weiner; Communications of the Association for Information Systems), 2020*	The researchers explore the elements of work that contribute to the workers' perception of control as being legitimate. Their findings are in line with prior research in the field, but the perspective of findings is different and more contemporary, what contributes to the topic conceptualization and advancement of research (Qs 2&3).	The main theoretical focus is on how people generally perceive organizational control and what kind of working conditions (e.g. autonomy) positively contributes to their perception of TMC legitimacy. The findings are useful for studying the motivation of workers in AM (Q1).	Gig economy, Online platforms, Technology-mediated control, Perceptions of control legitimacy, Conceptualization, Nomological network
6	*Working with Machines: The Impact of Algorithmic and Data-Driven Management on Human Workers (M. K. Lee, D. Kusbit, E. Metsky, L. Dabbish, 33rd Annual ACM Conference on Human Factors*	The article explores how the workers under algorithmic management react to and cooperate with the system, what are the factors that influence them and which ones they ignore. The results imply possible improvements to such systems (Qs 1,3,4).	The article provides interesting insights into workers motivation and how effective is the influence of the algorithmic leader at the workplace; how the system communications are perceived (Qs 1&4).	Algorithmic management, Human-centered algorithms, Intelligent systems, On-demand work, Sharing economies

	in Computing Systems – CHI), 2015			
7	*Big data and organizational design–the brave new world of algorithmic management and computer augmented transparency (H. Schildt, Innovation: Management, Policy and Practice), 2016*	It is one of the fundamental papers in the field at present, as it clearly explains the digital systems that are transforming the organizational design, its management and communications. It aims to conceptualize the topic and provide a solid fundamental perspective from it should be studied and researched (Qs 1-4).	Scientific Management, organizational transparency, information systems in organizational design (Q1).	Algorithmic management; big data; digitalization of management; computer augmented transparency; organizational design
8	*Algorithmic labor and information asymmetries: A case study of Uber's drivers (A. Rosenblat, L. Stark, International Journal Of Communication), 2016*	The article provides insights on how the algorithmic systems are designed in favor for the organization, what power and information asymmetries are present as opposed to what is promised for the workers. It also discusses workers engagement mechanisms that are in place (Qs 3&4).	Influence mechanisms and followers behavior. Showcases many system messages – some elements of the motivation theories could be investigated and reported in the findings (Q1).	On-demand economy, ridesharing, ride hailing, algorithm, labor, management, entrepreneurship, independent contractor, sharing economy
9	*Algorithmic Management: The case of Airbnb (M. Cheng, C. Foley, International*	Basically, the researchers are exploring the reported data of Airbnb hosts in the contexts of the existing research and	The background of the article is the prior research on algorithmic management, so it does not employ the	Algorithm, Airbnb, Sharing economy,

	Journal Of Hospitality Management), 2019	literature on algorithmic management phenomenon. Adoption model of AM in Airbnb context (Qs 2&3).	fundamental subject perspective.	Human Resource Management
10	*Understanding perception of algorithmic decisions: fairness, trust, and emotion in response to algorithmic management (M.K. Lee, Big Data & Society), 2018*	The study provides a comprehensive viewpoint into how workers perceive the managerial decisions made and assigned by algorithms versus humans. The finding can help in approaching systems design and in navigating research direction (Qs 1-3).	How motivated and trustworthy the workers are are towards the algorithmic decisions, depending on the nature of the task it performs (mechanical vs human) (Qs 1&2).	Algorithmic management, perception, folk theory, fairness, trust, emotion
11	*Hands on the wheel: Navigating algorithmic management and Uber drivers (M. Möhlmann & L. Zalmanson, 38th International Conference on Information Systems, South Korea), 2017*	The article aims to conceptualize and define algorithmic management in the context of the IS management research domain. It takes into account previous studies on work autonomy, employment culture on digital platforms and socio-technical aspects of algorithms (Qs 2-4).	Communication and interaction between company and workers, autonomy at the workplace (Qs 1&4).	Algorithmic Management, Uber, Sharing Economy, Autonomy, Control
12	*Making platforms work: relationship labor and the management of*	Even though the article employs a totally different perspective on	The study is performed on digital platforms, which do not	Algorithmic systems, Algorithmic management,

	publics (B. Shestakofsky & S. Kelkar, Theory and Society), 2020	algorithmic management, it presents and explores a rising demand for relationship labor jobs on digital platforms. It showcases the relationship labor practices, which are used by some platforms and are similar to influencers (Qs 2 & 4).	function as direct labor providers (e.g. EdX).	Digital technologies, Organizational ethnography, Platform governance, Relationship labor
13	*Understanding Inequalities in Ride-Hailing Services Through Simulations (E. Bokanyi & A. Hannak, Scientific Reports), 2020*	The researchers demonstrate on practice how a small modification in algorithm can lead to more fairer outcomes for the workers (e.g. income distribution), showcasing the relative easiness of making improvements to the algorithmic systems (Qs 2&3).	The article focuses on more technical problems of algorithmic systems (income inequality despite the performance) and explores the issue by means of simulation and software adjustments.	Algorithmic management, algorithmic systems, ride-hailing services, system inequality
14	*Working in the digitized economy: HRM theory & practice (C. E. Connely, C. Fieseler, M. Cerne, S.R. Giessner, Human Resource Management Review), 2020*	The article reviews the present literature on the topic in the HRM domain. It shows different perspectives on the issues of the platform economy work, points out present research gaps and suggests further directions (Qs 1-3).	Human resource management functions (e.g. work engagement, performance evaluation, motivation). The article represents an integrative literature review, so does not focus much on fundamental	Gig economy, Gig work, Digitized economy, Crowdsourcing Crowdwork, Independent work, Platform work, Algorithmic control

			theories behind the topic.	
15	*The platform as factory: Crowdwork and the hidden labour behind artificial intelligence (M. Altenried, Capital & Class), 2020*	The researchers are confronting the viewpoint of perceiving the platform work and algorithmic management as a digitalization of Taylor's approach to management. They analyse the main elements of work under algorithmic management and prior research to support their viewpoint (Qs 1&2).	Taylor's management theory is the central focus of the analysis (Q1).	Crowdwork, digital labour, digital Taylorism, gig economy, platforms
16	*Perceived Organizational Support in the Face of Algorithmic Management: A Conceptual Model (N. Jabagi, A. Croteau, L.K. Audebrand, 53rd Hawaii International Conference on System Sciences), 2020*	The article aims to conceptualize the topic of algorithmic management and categorizes the digital platform by certain features. As a research output, the conceptual model is outlined on the elements affecting perceived organizational support in the context of algorithmic management (Qs 2&3).	Since the article explores the topic of algorithmic management in the context of the perceived organizational support (POS), it connects it with prior studies on POS. However, the article nicely unites the literature on AM, providing a unified perspective (Q2).	Algorithmic management, digital labor, platforms, gig-economy, gig-work, perceived organizational support
17	*Breaking the vicious cycle of algorithmic management: A*	Provides a clear overview of the algorithmic systems elements that affect	Focuses on ethical aspects of human motivation towards virtue execution, can	People Analytics, Virtue Ethics,

	virtue ethics approach to people analytics (U. Gal, T. B. Jensen, M. Stein, Information and Organization), 2020	employees behavior and their pursuit of virtue at the workplace. Points out the research gaps from the ethical perspective on the topic (Q 2 & 3).	be connected with some elements of motivation theories (Q1).	Algorithmic Management
18	*Algorithmic Decision-Making Based on Machine Learning from Big Data: Can Transparency Restore Accountability? (P. B. de Laat, Philosophy & Technology), 2017*	The article gives a valuable perspective on making the algorithmic decision-making fully transparent and demonstrates why it is ultimately not a good idea (Qs 2-4).	The article does not link the topic to any management or leadership theories, but it fits well into the topic by providing a counter argument for a frequently discussed issue (transparency) in the present literature on the topic.	Accountability, Algorithm, Interpretability, Machine Learning, Opacity, Transparency
19	*The organisation and experience of work in the gig economy (S. Kaine & E. Josserand, Journal of Industrial Relations), 2019*	The article plays a major role for the field. The researchers conduct a systematic literature review on gig-economy, analyse the main keywords found in literature and classify material into themes. The valuable findings and research gaps are presented and discussed (Qs 1-4).	The article mentions the functions of algorithmic management from existing literature. It discovers an interesting aspect of social media usage in gig-work and its role in this unusual employment setting, in which there is lack of communication (Q4).	Algorithmic management, Digital platforms, Gig economy, Gig work, On-demand work, Text mining
20	*In the age of the smart artificial intelligence: AI's*	By clearly outlining the two types of AI applications in	For the context of the analysis, Zuboff's theory of	Algorithmic management, Artificial

	dual capacities for automating and informating work (M. H. Jarrahi, Business Information Review), 2019	management (for automation & for information), the article brings value into the conceptualization of the field of algorithmic management. Practical implications are also discussed (Qs 1-3).	computerization and automation is taken. The theory explores the influence of IT on work practices and the consequences of computerisation.	intelligence, Augmentation, Automating, Informating, Intelligent machine
21	*Gig-workers' motivation: thinking beyond carrots and sticks (N. Jabagi, A. Croteau, L. K. Audebrand, J. Marsan, Journal of Management Psychology), 2019*	The paper makes an important contribution in studying the workers' motivation under algorithmic management. It also defines and classifies platform types based on difference in their purpose and work performed (skill level & type of service) what other papers in the field are usually neglecting to take into account (Qs 1-3).	The article adapts the Self-Determination Theory of motivation, as it correlates with organizational commitment, and applies it to the context of gig-work. It explores the intrinsic and extrinsic motivation aspects within it (Q1).	Gig-work, motivation, Platform-enabled digital marketplace, Digital labor platforms, Gig economy, Self determination theory
22	*The Effects of Autonomy and Task meaning in Algorithmic Management of Crowdwork (Y. Toyoda, G. Lucas, J. Gratch, 19th International Conference on Autonomous Agents and*	By means of experimental study, researchers were able to explore the ways how algorithmic management can increase workers' engagement on the task. The findings provide important insights for the field (Qs 1-4).	Self-determination theory, work autonomy and task meaning for the worker are the central theoretical concepts that are tested within the experiment and, in particular, algorithmic management context (Q1).	Algorithmic management, Worker motivation; Crowdwork; Feedback system; Self determination theory

	Multiagent Systems), 2020			
23	*Algorithmic management and app-work in the gig economy: A research agenda for employment relations and HRM (J. Duggan, U. Sherman, R. Carbery, A. McDonel, Human Resource Management Journal), 2019*	The article provides an in-depth analysis of how the managerial functions are executed within the app-based gig work. It also classifies gig work platforms, based on work arrangement, what brings more clarity into existing research on the topic (Qs 2-3).	The context of the study is human resource management and its typical functions within an organization. Researchers are pointing out the problems of having HRM functions in place, but treating workers as non-employees (Qs 1&3).	Algorithmic management, App-work, Employment relations, Gig economy, HRM, Precarious employment
24	*Algorithmic Management and Algorithmic Competencies: Understanding and Appropriating Algorithms in Gig work (M. H. Jarrahi, W. Sutherland, Information in Contemporary Society; iConference) 2019*	Researchers study the practice of algorithmic management in the context of freelance work platforms. Their findings of workers' interaction and experience of work under AM is important, as it demonstrates how different it is from other platform-work types (e.g. Uber) (Qs 2-4).	The study does not aim to conceptualize the topic of algorithmic management, so does not provide any theoretical connection to human management theories. The findings, however, are helpful for benchmarking the platform labor practices with human ones.	Algorithmic management, Algorithmic competency, Gig work, Online freelancing
25	*Digitalization of work and heteronomy (A. Mengay, Capital & Class), 2020*	The article provides a valuable perspective on labor transformation due to digitalization. It explores the concepts	Marx's Labor Process Theory, which discusses the problem of transforming the power over labor	Re-Taylorisation, Algorithmic control, Digitalization, Labour process,

		of autonomy and control and explores the existing and potential effect of digital transformation on them (Qs 1&2).	into actual labor. The application of technology in this process brings the risk of loss of autonomy for the labor workers (Qs 1-3).	Indirect control, Formalization
26	*Dependence and precarity in the platform economy (J. B. Schor, W. Attwood-Charles, M. Cansoy, I. Ladegaard, R. Wengronowitz, Theory & Society), 2020*	The article provide three different literature perspectives on the topic of platformic labor, contributing to the conceptualization of the algorithmic management perspective, by distinguishing it from others (Qs 2&3).	The article overviews the existing literature on the topic of platformic labor extensively, not aiming to connect and benchmark it with established management theories (Qs 2&3).	Airbnb, Algorithmic control, Economic dependence, Platform labor, Precarity, Sharing economy, Uber
27	*The Impacts of Algorithmic Work Assignment on Fairness Perceptions and Productivity: Evidence from Field Experiments (B. Bai, H. Dai, D. J. Zhang, F. Zhang, H. Hu, Social Science Research Network (SSRN)), 2020*	The article provides important findings on how algorithmic decisions are perceived. The empirical findings support the other literature in the field in regard that mechanical managerial tasks (work assignment) are perceived as more fair when done by algorithms (Qs 2).	As the study uses the primary data, its main goal is not to connect and ground the topic within the historical theoretical context, but rather to aid the new theory development in the field.	Behavioral Operations, Field Experiment, Productivity, Fairness, Artificial Intelligence
28	*Mediatization of social space and the case of uber*	The article provides valuable insights on employees' social	The focus of the study is on the social space at work	Datafication, mediatization, gig-work

	drivers (H. Lee, C. N. Keung, Media and Communication), 2018	practices in the platform economy. The empirical findings on how workers under algorithmic management mitigate the work challenges by creating a social space is in line with other studies on the topic. Research gaps are addressed (Qs 2-4).	and how it has been digitalized in the platform economy. Fundamental leadership and management theories are not discussed.	
29	*Platformic Management, Boundary Resources for Gig Work, and Worker Autonomy (M. H. Jarrahi, W. Sutherland, S. B. Nelson, S. Sawyer, Computer Supported Cooperative Work (CSCW)), 2019*	The researchers define and advance the concept of platformic management, showing a clear distinction of it from algorithmic management by outlining the tasks, pros & cons that are part of each phenomena. As a main output, the article outlines functions prior to platformic management (Qs 2&3).	The article focuses on closing the gap in existing literature on algorithmic platforms by studying the knowledge-intensive labor platforms instead of on-demand platforms and the issue of the perceived autonomy of those. It outlines the managerial functions platforms execute (Qs 1&4).	Gig work, Knowledge work, Upwork, Platformic management, Algorithmic management, Autonomy paradox, Boundary resources, Sociotechnical systems
30	*Procedural Justice in Algorithmic Fairness: Leveraging Transparency and Outcome Control for Fair Algorithmic Mediation (M. K. Lee, A. Jain, H. J.*	The article explores the existing problems within the algorithmic management systems and suggests the ways on how to make the human-computer interaction process in the AM context more fair (Qs 2&3).	The theoretical focus is on the technology side (procedural justice in algorithmic decision-making), so no connection to management or leadership theories are present.	Algorithmic decision, Algorithmic mediation, Transparency, Control, Division

	Cha, S. Ojha, D. Kusbit, ACM on Human-Computer Interaction), 2019			
31	*Rendered Inoperable: Uber And The Collapse Of Algorithmic Power (L. Munn; A Peer-Reviewed Journal About (APRJA)), 2018*	The main contribution of the article is that it clearly demonstrates why the power of algorithms is not effective, how the system lacks personalization and accountability of the actual work performance. The researcher outlines three technical phenomena which frame the platform workers (Qs 1-4).	The insights provided by the article help to study the motivation elements of workers under algorithmic management. Besides, the leverages for power can be benchmarked on the algorithmic context (Q1).	Algorithmic ecology, Algorithmic power, Affective labor
32	*A "Circuits of Power"-based Perspective on Algorithmic Management and Labour in the Gig Economy (D. Pastuh, M. Geppert, Industrielle Beziehungen), 2020*	The article provides an interesting viewpoint on the topic of power within organization – how it circulates and what kind of influences it produces over the existing organizational parties – exploring the differences of these in the algorithmic context (Qs 1-3).	The central focus of interest is on the concept of power and influence, which are considered to be constituting leadership practice, so this is an important context for the topic conceptualization (Q1).	Uber, Gig work, Platform economy, Power, Circuits of power, Algorithmic management, Organisational control, Labour conditions
33	*Algorithmic management: issues for organizational theory and design*	The researchers outline definite consequences of automating management in	Theoretical connection to human management theories is not present, as the	Concepts mentions in text: Management automation,

	(S. Faraj; Academy of Management Proceedings), 2019	organizations by AI and algorithmic systems. Their statements are in line with the actual practical examples of such systems (e.g. labor platforms) observed in many research studies (Qs 2-4).	article aims to focus on the organizational perspective and consequences of automation.	algorithmic decision-making
34	*Theoretical Framework for Understanding Human Trust in Artificial Intelligence (Glikson, E. & Woolley, A.W.; Academy of Management Proceedings), 2019*	The article helps to conceptualize the topic by bringing more clarity into understanding of human trust in AI systems, depending on the level of their level of embodiment and role. The findings demonstrate that with AI as a manager, very high emotional and cognitive trust is required on all embodiment levels (Qs 2-4).	Depending on the levels of embodiment of the AI and the role it serves, the level of emotional and cognitive trust in it will vary. Based on prior theories in the field, the framework is presented for further studies in the field.	Concepts mentions in text: Algorithmic management, AI as a manager, as a tool and as an assistant
35	*"Exploring Automated Leadership and Agent Interaction Modalities" (D. C. Derrick, J.S. Elson; 52nd Hawaii International Conference on*	By means of experimental study, researchers explore how people perform a task with and without an algorithmic leader's presence. The researchers attempt to automate transactional	Transactional leadership and its functions of goal setting, performance monitoring and performance consequences. Among the theories they base their study on is also the	Transactional leadership Automation, Intelligent agents, Social presence, Hologram, Embodied agents

	*System Sciences), 2019**	leadership in a group setting and to explore its effects on followers' satisfaction, their perceptions of a leader and overall group effectiveness. (Qs 2&3).	Leader-Member Exchange Theory (Qs 1&4).	
36	*Automated leadership: Influence from embodied agents (D. C. Derrick, J. S. Elson, HCI in Business, Government, and Organizations (pp.51-66)), 2018*			
37	*"Algorithmic Management for Improving Collective Productivity in Crowdsourcing" (Yu, H., Miao, C., Chen, Y., Fauvel, S., Li, X., & Lesser, V. R.; Scientific Reports), 2017*	The researchers propose an innovative algorithmic approach, Surprise-Minimization-Value-Maximization (SMVM), which, based on Work Desirability Index, suggests an individual course of action for the worker, contributing to his motivation and to collective productivity in the end (Q3).	The article represents a mathematical computer program-based experiment, so does not provide any linkage to the theoretical background on the topic, except that some of its findings can be projected on human motivation theories (Q1).	Concepts mentions in text: Algorithmic management, Collective productivity, Crowdsourcing

Table 3. Final set of selected material of the SLR process with justification for the inclusion.

*Note: the articles 35 & 36 have the same content, with slightly modified text, so can be considered duplicates, but are both acknowledged here separately, for more transparency and clarity of the material amount and selection for the review.

4.4 Snowballing Material Linking

The results of the additional material discovered when the snowballing technique has been applied to the final set of SLR articles (Table 4) are outlined in this chapter. The original article, from the references of which the new papers come from, has been specified, in order to keep the transparency of this review. Both backward and forward snowballing techniques have been applied to the original set of papers. Many

of them are citing and referencing each other, so the results produced from the snowballing method have not been voluminous.

№	Original article	New material	Reason for inclusion	Article's keywords
1	Jarrahi, M. H., & Sutherland, W. (2019). Algorithmic Management and Algorithmic Competencies: Understanding and Appropriating Algorithms in Gig Work.	Sutherland, W., & Jarrahi, M. H. (2018). The sharing economy and digital platforms: A review and research agenda. International Journal of Information Management, 43, 328–341.	A complete literature review on sharing economy, conceptual framework on centralization on the platforms, research perspectives towards technology. The researchers are using an interesting set of keywords, fully different from the ones used for this review, so their literature findings help to reinforce the perspective on the topic and formulate the research field boundaries better (Qs 2&3).	Sharing economy, Collaborative consumption, Gig economy, Platform economy, Digital platforms
2	Schor, J. B., Attwood-Charles, W., Cansoy, M., Ladegaard, I., & Wengronowitz, R. (2020). Dependence and precarity in the platform economy.	Vallas, S., & Schor, J. B. (2020). What Do Platforms Do? Understanding the Gig Economy. Annual Review of Sociology, 46(1).	The article represents a comprehensive literature review on the research field of platform labor. The main value for the review that it brings is that it outlines four different ongoing trends/perspectives present in the existing body of literature. This contributes to the field understanding and conceptualization (Qs 1-3).	Platform economy, Gig work, Precarious work, Digital revolution, Sharing economy
3	Gal, U., Jensen, T. B., & Stein, M.-K. (2020). Breaking the vicious cycle of algorithmic management: A virtue ethics	Mateescu, A., & Nguyen, A. (2019). Algorithmic management in the workplace. Data & Society, 1–15.	Contrasting to the viewpoint on algorithmic management being a phenomenon related to such platforms, as Uber, where the labor is directly managed and dependency of workers from the system is visible (e.g. no any human	Concepts mentioned in text: Algorithmic management, Algorithmic systems

	approach to people analytics.		manager), the article employs a viewpoint that AM is a phenomenon much more broad and can be observed in many other context, where at least one management function has been automated (e.g. scheduling) (Qs 2&3).	

Table 4. The additional review material resulting from the snowball method.

5 RESULTS

The current literature review analyzes the selected material through the prism and with an objective to find definitive answers to the stated research questions. This section starts with the description of the gathered material, in order to formulate a general perspective of the field and selected publications. Then, the literature is divided into several categories based on the certain unifying aspects (highlighted with headings; based on research questions), which are reviewed and presented separately to achieve more clarity of the dissemination process and for the ease of the reader.

5.1 Material Description

The final outcome of the systematic review and application of the snowball method to the SLR material has yielded 40 articles in total (Table 3 & 4). This subchapter overviews the literature in the research field at the moment by means of descriptive data. This includes the years of publication of the papers on the topic, research approaches undertaken so far and also the variety of terms used to address similar phenomena.

The bar chart below (Figure 5) demonstrates the timeline and distribution of the publications on the studied topic of management automation. The first theoretical contributions were made in 2015. At that time, the term "algorithmic management" was first introduced and coined by Lee et al., while the term "algorithmic leadership" was first mentioned only in the year 2019 by Harms and Han. More than a half of the material was published between 2019 and 2020 years (28 articles out of 40), indicating that the field is just emerging. It is also possible to observe that there was a rapid increase in interest towards the topics of corporate leadership and management automation in the past two years. Thus, providing a timely perspective on the current trends and ambiguities in the field should facilitate its establishment and guide towards a uniform consistent direction.

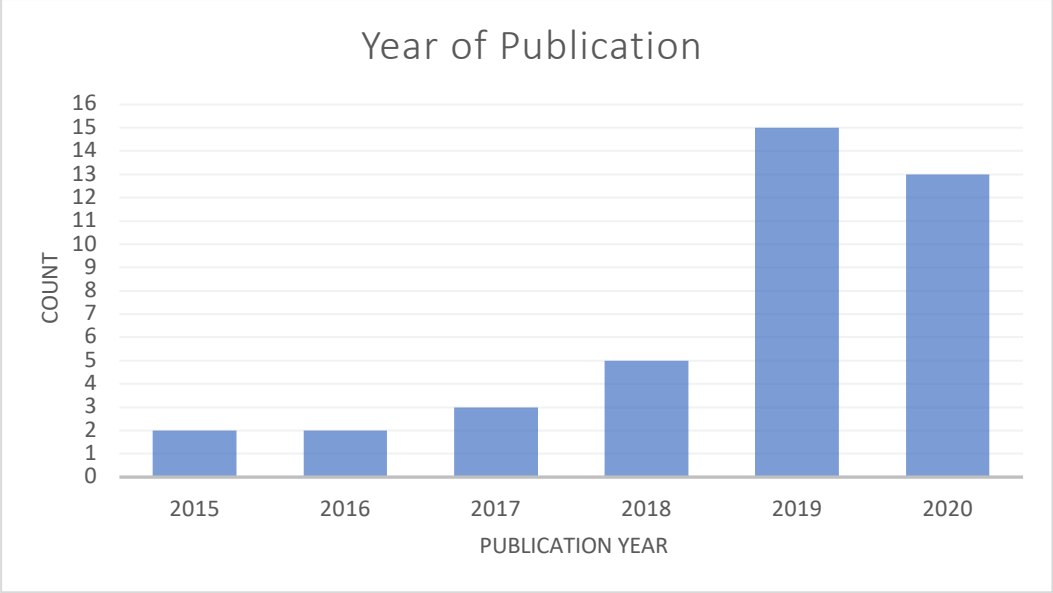


Figure 5. The distribution of publication years within the review material.

Another interesting observation is how the topic investigation has been so far approached in the field in terms of data collection and research methodologies. Figure 6 shows all approaches undertaken in the selected publications and their percentage of the total amount. The most common approach was an integrative or narrative literature review. According to Snyder (2019), integrative literature review is a research method aimed to criticize, assess and synthesize the literature on the topic, in a way that would facilitate the emergence of new theoretical frameworks and perspectives. With this approach, both well-established and emerging topics can be studied. In case of an emerging topic, like the topic of focus, the purpose of an integrative review can be to conceptualize and to create new theoretical models. The process of such review can be creative in terms of data collection, as its purpose is not to cover all existing literature in the field, but to overview it and to present some of the existing perspectives (Snyder, 2019).

There have been several empirical studies done in the field, but overall, it can be concluded that they are lacking at the moment, while such a big amount of narrative literature reviews possesses certain threats, as they are considered to be subjected to researcher's bias (Tranfield et al., 2003; Snyder, 2019).

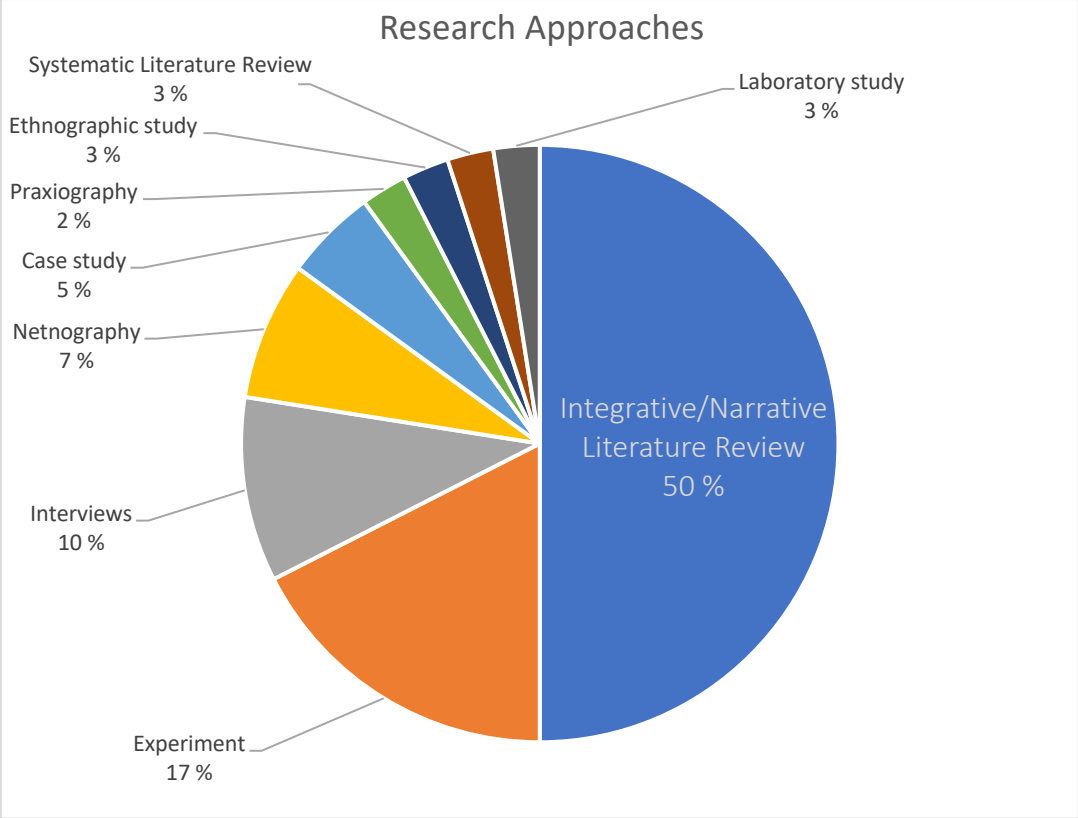


Figure 6. The variety and frequency of research approaches in the field.

From the Figure 7, it can be observed that the terms used in the field are very scattered, even though most of them address the same or similar phenomena. The most commonly encountered term was "algorithmic management", which has been used by many researchers after the introduction by Lee et al. (2015), not without the attempts to redefine and reconceptualize it, however (e.g., Möhlmann & Zalmanson, 2017). In total, there were 59 different terms uncovered in literature, among which only 7 have been used by more than one author. This finding indicates that the field is undergoing its development and this demonstration is targeted towards bringing more clarity into the current state-of-the-art and into the future studies on these topics.

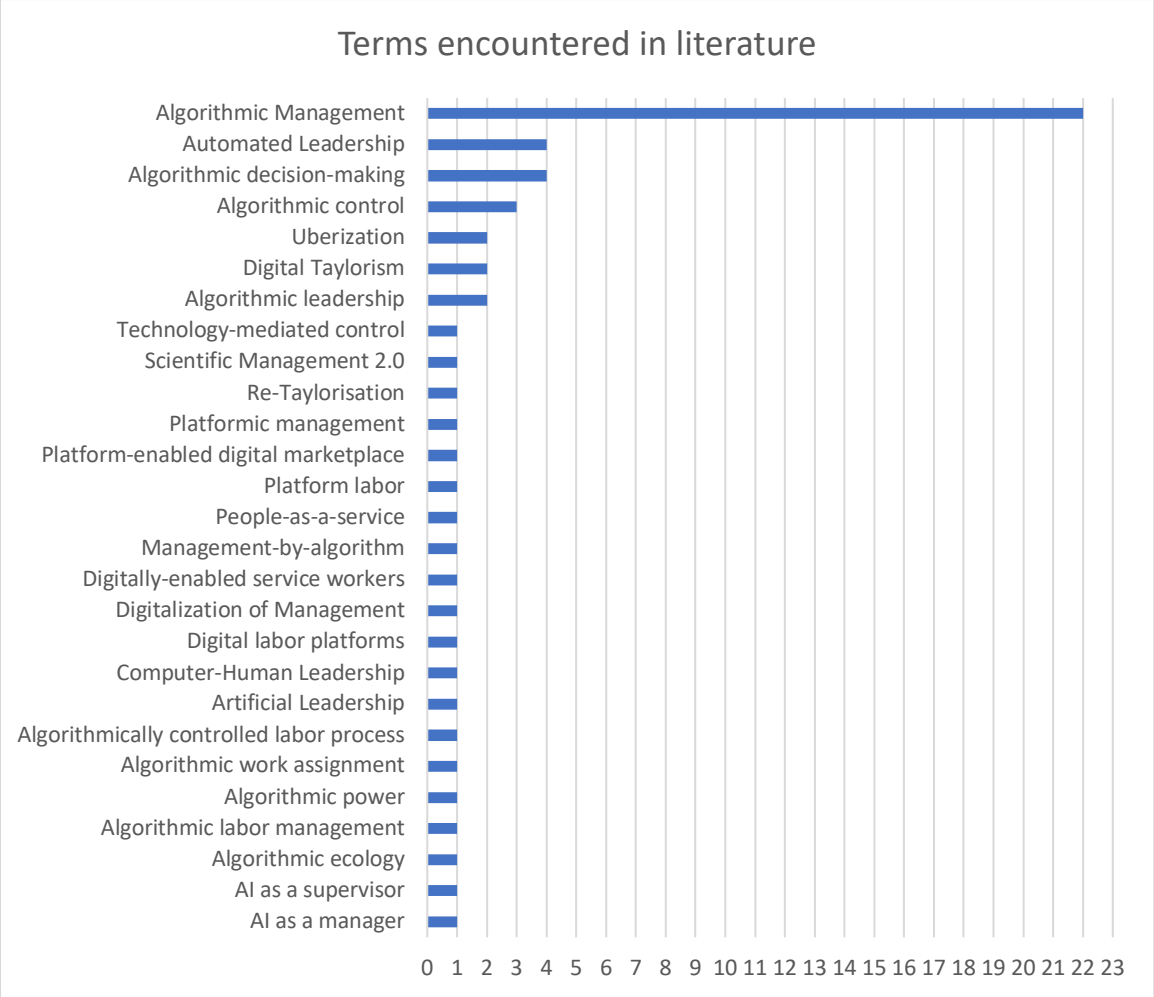


Figure 7. Terms encountered in the selected set of literature for the SLR (author's findings –terms are not from the official article's keywords).

5.2 Algorithmic Leadership and Management

The following reporting of the discovered material is divided into several subchapters, based on the research questions of the study. This is done in order to make the process of reporting and dissemination of data more clear and easier to follow. Section 5.2.1 overviews the literature, in which algorithmic leadership is either defined or if the phenomenon is studied, but addressed differently, and if the attempts to conceptualize it are made. Section 5.2.2 presents the existing definitions of algorithmic management and some of its present conceptualization perspectives, along with the traditional theories that have been connected with it. Section 5.2.3 presents the problems and critical perspectives on algorithmic management, as well as potential improvements of the practice. The final section 5.2.5 discusses how communication processes happen in these systems when human managers are completely replaced by technology and several aspects related to it. Direct answers to the research questions are provided in the discussion (chapter 6).

5.2.1 Algorithmic Leadership

Authors	Title	Contribution
Harms & Han, 2019	*Algorithmic Leadership: The Future is Now.*	Connects algorithmic leadership and management concepts, providing more clarity to the topic.
Wesche & Sonderegger, 2019	*When computers take the lead: The automation of leadership.*	Conceptualizes the phenomenon as computer-human leadership; introduces the revised TAM model for algorithmic leadership adoption.
Uhlin & Crevani, 2019	*Is e-leadership development enlightening? Handling fragmentation by making leadership algorithmic.*	Nominates algorithmic leadership (fully automated by a machine) to be a viable solution to the present deficiencies of e-leadership.
Parry, Cohen, & Bhattacharya, 2016	*Rise of the Machines: A Critical Consideration of Automated Leadership Decision Making in Organizations.*	Explores the possible scenarios of automating corporate leadership (top-management); employs the most accurate perspective of what algorithmic leadership is (or will be).
Derrick & Elson, 2018	*Automated Leadership: Influence from Embodied Agents.*	Outline the consequences of embodied (computer) leader coordinating workers on their performance and perception of the task completion process.
Derrick & Elson, 2019	*Exploring Automated Leadership and Agent Interaction Modalities.*	

Table 5. Articles discussed in this subchapter.

I would like to open the discourse with a symposium paper by Harms and Han (2019), because this paper is a gateway into the topic of leadership and management automation, and it sets the direction for the whole research field. It is, basically, fundamental, because it provides definitions for both *algorithmic leadership* – practice in which AI systems are supporting, motivating and developing workers, - and *algorithmic management* – when such systems are aimed at organizing and controlling subordinates, mainly by means of financial incentives and firing threats (Harms & Han, 2019). Even more importantly, it demonstrates the linkage (or rather a transition) between two, noting that in algorithmic management systems (e.g., Uber) the need for better corporate communications, leadership and motivation of workers has been

recognized, which is also true from the research perspective, as the following sections will demonstrate. In addition, Harms and Han are the first to define the elements of algorithmic leadership being those of e-leadership, shared or distributed leadership and substitutes for leadership (Harms & Han, 2019).

Supporting this vision, Uhlin and Crevani (2019) discovered in their study on e-leadership, when leadership training was executed through digital technologies (e.g., virtual teams), that people have experiences fragmented interactions, which has led to bureaucratization of the process. Thus, the researchers surmise that the problem of fragmentation can be tackled if e-leadership process becomes algorithmic and is delegated to a machine or a robot.

Advancing higher on the hierarchy of leadership in an organization, Parry, Cohen and Bhattacharya (2016) are discussing the automation of top management activities, such as strategic decision-making. The researchers outline several possible scenarios of delegating the leadership of the whole organization to an intelligent computer system. They come to conclusion that fully delegating the decision-making to such a system (where no human veto will be present) is rather unlikely, as it might be challenging from the ethical and motivation perspectives. At the same time, this could make a decision-making process de-individualized, remove the power distance barriers along the organizational hierarchy and making the subordinates perceive the decisions and directions less emotionally, lowering the threat of affecting their trust based on the assumptions of bias and personal benefits maximization of a human leader and, thus, possibly neutralizing organizational conflicts (Parry et al., 2016). In the scenario, where a human does hold veto over the decisions made by the AI, de-individualization might not produce such a plausible effect, and, moreover, the decisions with any negative connotations might be perceived even worse, as the subordinates might oversee an imposed rationalization from top-management referring to the computational reliability of the AI to justify them. According to Parry et al. (2016), the compromise between the two scenarios can be achieved through creating a critical event log, where every time the AI-decision produced is not optimal and has to be modified by a human leader, such instance will be recorded into the backlog, while the decision re-generated. Basically, in this setting, the human leader should always be present, while the iterations will also provide more data to the machine algorithms and make them more accurate with the time. The visual representation of the process is presented as a flow chart diagram (in Appendix 1).

Supporting the idea of technology taking over leadership activities in organizations at some point in the future, Wesche and Sonderegger (2019) attempt to conceptualize the phenomenon and introduce the term Computer-Human Leadership (CHL), which they define as *"a process whereby purposeful influence is exerted by a computer agent over human agents to guide, structure, and facilitate activities and relationships in a group or organization."* The researchers are building their conceptualizations deriving the elements from existing leadership (e.g., Yukl, 2013) and Human-Computer Interaction theories. Based on the Technology Acceptance

Model (TAM), which is used to explore what influences the adoption of a computer system by a human user, the researchers outlined the L-TAM model, which can be used to predict the likeness of a computer system usage/adoption, which would act as a leader (figure 8). Wesche and Sonderegger (2019) emphasize that the acceptance from the subordinates will be of crucial importance in CH leadership, as in its case the user will have to obey and/or follow the system in the context of a task completion process. Their research, however, did not focus on the fully automated leadership processes and neither it focused on what specific leadership functions can be automated and which not.

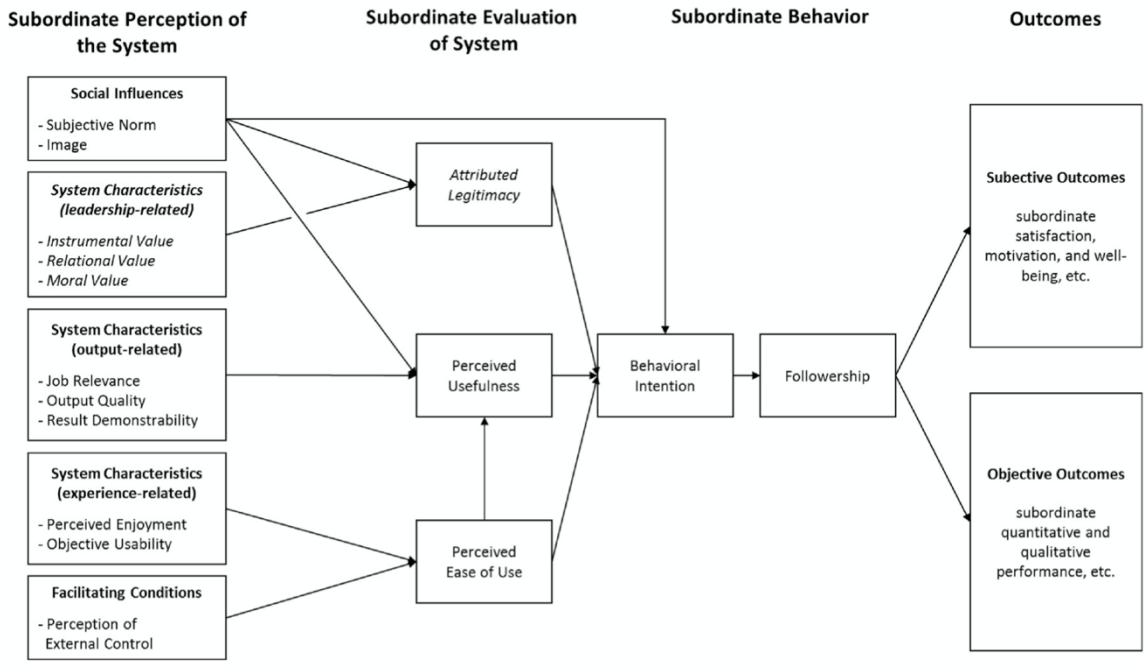


Figure 8. L-TAM model for the technology acceptance mechanisms in CH Leadership context (note: attributed legitimacy and social influence formulate the behavioral intention and, thus, are the crucial components for the CHL to be effective) (Wesche & Sonderegger, 2019).

The last two articles by Derrick and Elson (2018 & 2019) presented in the table are, basically, duplicates, as the research experiment and findings are the same. However, since they have a different name and are published in different sources with slight changes in text, I believe, it is important to note and report for more clarity of the selection process and for the indication of such an instance. The rest of the material excluded duplicates, meaning the articles that are fully identical (by name, text and source).

The experiment conducted and discussed in Derrick's and Elson's (2018 & 2019) articles produced valuable findings for the further conceptualization of the algorithmic leadership phenomenon, as it was targeted directly on exploring how people perform the task under the embodied text computer agent, who is imitating a

transactional leader and interacts with them through different messages. Among the information they asked the participants to report after the experiment were, for instance, their satisfaction of the process and its outcome, Leader-Member-Exchange (LMX) perception (questionnaires used were not specified by researchers), degree of social presence of the agent. The transactional leadership is defined by Derrick and Elson (2019) as a process aimed at goals and plan implementation, which is built around the exchange of the things of value between the leader and subordinates, in order to advance the agendas of both parties. The findings from the experiment indicate that the performance and quality of the task were better when an artificial leader *was* present. On the contrary, the overall process of working on the task and the final outcome from it satisfied the participants less, when they were performing it having a leader. All in all, the article confirms the hypothesis that the transactional leadership can be automated (at least to a certain extent), which is also in line with Harms' and Han's presumption (2019), and that it leads to better performance results.

5.2.2 Algorithmic Management

Author(s), Year	Title	Contribution
Schildt, 2016	*Big data and organizational design – the brave new world of algorithmic management and computer augmented transparency.*	Explains and conceptualizes algorithmic management as a type of a corporate management system.
Lee, 2018	*Understanding perception of algorithmic decisions: Fairness, trust, and emotion in response to algorithmic management.*	Explores how differently human versus algorithmic manager's decisions are perceived.
Lee, Kusbit, Metsky & Dabbish, 2015	*Working with Machines.*	Introduced and defined the term "algorithmic management".
Möhlmann & Zalmanson, 2017	*Hands on the wheel: Navigating algorithmic management and Uber drivers.*	Reconceptualized and redefined algorithmic management.
Bing, Hengchen, Zhang D., Zhang F. & Haoyuan, 2020	*The Impacts of Algorithmic Work Assignment on Fairness Perceptions and Productivity: Evidence from Field Experiments.*	Contributes to the study of weather the task assignment done by algorithms is perceived more or less fair than by a human.

Jarrahi, 2019	*In the age of the smart artificial intelligence: AI's dual capacities for automating and informating work.*	Supports the perspective of Schildt (2016) on types of AI-powered management systems, outlining their practical benefits.
Jabagi, Croteau, Audebrand, 2020	*Perceived Organizational Support in the Face of Algorithmic Management: A Conceptual Model.*	Presents a model of perceived organizational support in algorithmic management.
Faraj, 2019	*Algorithmic management: issues for organizational theory and design.*	Outlines organizational consequences for the scenario when management becomes fully automated by AI.
Wiener, Cram & Benlian, 2019	*Technology-Mediated Control Legitimacy in the Gig Economy: Conceptualization and Nomological Network.*	Conceptualize algorithmic management from a perspective of organization control.
Altenried, 2020	*The platform as factory: Crowdwork and the hidden labour behind artificial intelligence.*	Contributes to the comparison of algorithmic management and Taylor's theory.
Jarrahi, Sutherland, Nelson & Sawyer, 2019	*Platformic Management, Boundary Resources for Gig Work, and Worker Autonomy.*	Introduces a new term "platformic management" and distinguishes it from algorithmic management.
Sutherland & Jarrahi, 2018	*The sharing economy and digital platforms: A review and research agenda.*	Demonstrates that there is an emerging body of literature on "sharing economy", which neglects researching the technology or algorithmic management side of the platform-based labor systems.

Table 6. Articles discussed in this subchapter.

Even though there were many articles, which mentioned algorithmic management, this section will focus and discuss only the ones that are more fundamental for the topic – those, which provide a definition of the algorithmic management phenomenon, thoroughly discuss it and/or compare with existing theories in an attempt to conceptualize it. However, there are also articles that can be considered outliers, because they employ a different conceptualization viewpoint/approach, but, I believe, that their representation here is still important for a formulation of a complete perspective on the ongoing dialogues in the research field. The section will open with the current definitions of algorithmic management.

Present Definitions and Terms

Lee, Kusbit, Metsky, and Dabbish (2015) were the pioneers in the field, introducing the term **"algorithmic management"** and defining it as *a practice, where software algorithms supplemented by technology devices undertake the functions normally executed by human managers*. Lee et al. (2015) used the term in the context of platforms like Uber and Lyft, which was the main focus of their study. The term was both used and argued by many in the field since then and its conceptualization only took off from a starting point.

Schildt (2016) based his conceptualization on Lee et al.'s (2015) definition, but he was the first one to address it as **"scientific management 2.0"**. With such naming, Shildt emphasized that management has become a process executed by technology and not by a human being, referring to Taylor's theory of management, which is known for strict rules and aims at maximum efficiency of operations (as discussed in Chapter 2.1.1). In his article, the author also postulates that *"algorithmic management, or Scientific Management 2.0, shifts power from a hierarchy of managers to larger cadres of professionals who master analytics, programming, and business"*, pointing out the fact that there are still people in charge, they are just not managers anymore and are out of sight of the workers (Schildt, 2016).

In the following year, Möhlmann and Zalmanson (2017) came up with their own conceptualization of the phenomenon. Based on their comprehensive study on Uber drivers and their experience of work, researchers re-defined algorithmic management as *"oversight, governance and control practices conducted by software algorithms over many remote workers"* (Möhlmann & Zalmanson, 2017). The researchers deemed it necessary to point out that algorithmic management is not, actually, the same practice as human management, simply delegated to algorithmic systems, contradicting the viewpoint of Lee et al. (2015). Instead, what happens is that workers are being constantly tracked and evaluated, while the decisions are automatically implemented, based on the gathered data, which is not quite similar to what human managers do (Möhlmann & Zalmanson, 2017). Nevertheless, the definition of Lee et al. (2015) still prevails in the field and is referred to by many researchers.

Wiener, Cram, and Benlian (2019) discovered and introduced their own interpretation of the concept. They called the same phenomenon, where algorithms are controlling the labor processes, as **Technology Mediated Control (TMC**), defining it as *"the managerial use of advanced digital technologies (e.g., Internet of Things [IoT] sensors, mobile apps, wearable devices) and smart algorithms as a means to influence workers to behave in a way that is consistent with organizational expectation".* The researchers considered this concept to be very much in line with past conceptualizations of algorithmic management by Lee et al. (2015) and Möhlmann and Zalmanson (2017). In their point of view, there are two types of TMC – one, supporting the management of an organization, - and the other, automating it (e.g., in Uber). The latter type, basically, represents the algorithmic management practice (Wiener et al., 2019).

Mateescu and Nguyen (2019) in their explanatory article on what algorithmic management is and what are its attributes and present applications, defined is as *"a diverse set of technological tools and techniques that structure the conditions of work and remotely manage workforces."* They explained this phenomenon as a replacement of humans directing and supervising workers by technology. The researchers also specified that algorithmic management systems are effective for scaling operations, as they are able to monitor and coordinate large workforce activities, along with utilizing the data to optimize workers for achieving desired business outcomes (e.g. cutting labor costs) (Mateescu & Nguyen, 2019).

Duggan, Sherman, Carbery, and McDonnell (2019) defined algorithmic management (or as they also called it **"management-by-algorithm"**) as "*a system of control where self-learning algorithms are given the responsibility for making and executing decisions affecting labor, thereby limiting human involvement and oversight of the labor process."* The researchers specified that in such systems algorithms are in charge of the processes normally executed by HR department – for example, work assignment and performance management (Duggan et al., 2019).

Despite (or maybe due to) the amount and variety of definitions, there are certain ambiguities in the field. The main reason for this is the fact, that nowadays there are many different platforms – from ridesharing and house sharing to freelance and food delivery. Some of them provide a possibility to work, while some do not, plus, they all have certain differences in terms of how they are designed and how the processes are executed. Nevertheless, the clear distinction between them was missing in the filed till a certain point, and the term "algorithmic management" was used even in regard to Airbnb (e.g., in a study by Cheng & Foley, 2019), even though there is no actual labor happening on the platform.

Building on this observation, Jarrahi, Sutherland, Nelson, and Sawyer (2019) were among the first in the field to address this inconsistency and to advance the development of a different concept, which they called **"platformic management",** separating it from "algorithmic management" and focusing it only on the platforms, where knowledge-intensive work is performed (e.g., freelancing platforms like Upwork). The researchers point out that there is a lack of research on how

management is organized on this type of platforms, bearing in mind that they have an actual support department with real people, who execute certain management functions by technology means, which Jarrahi et al. (2019) outline from their study.

From the existing variety of definitions and no agreed usage of terms in the field, it can be clearly seen that the field undergoing its formulation and establishment. The same can be observed in terms of research perspectives undertaken to explore, in particular, algorithmic management, but also overall platform labor – they are diverse. The rest of this chapter will describe the present attempts and approaches to conceptualize the topic.

Organizational Perspective

Schildt (2016), Jarrahi (2019) and Faraj (2019) are the ones who took organizational perspective and, in particular, examined **the role of technology systems in organizational structure and design**. Shildt (2016) classified AI-powered systems used by organizations into two distinctive categories – optimizing-oriented and open-ended. Optimizing-oriented are the ones that aim at optimization of the key processes, for example, they evaluate the performance of employees and optimize the decisions regarding task assignment and their employment in general. This is enabled by big data and learning algorithms. According to Schildt (2016), the examples of such systems are "algorithmic management" ones – those capable of firing employees, like Uber or Deliveroo, and also the ones that are responsible for scheduling work, for example, in fast food restaurants or retail stores. Schildt (2016) uses the term "scientific management 2.0", because the organization of work under these systems is similar to Taylor's theory of management – it is targeted to optimize the processes to maximize efficiency of operations, disregarding workers motivation and humanistic approach. The other type of the systems, open-ended, are designed to provide information extracted from data (both numeric and text, e.g., messages). These systems can generate transparency on certain processes within organization, which can possibly be beneficial for both managers and employees and can contribute to better organization of work for both stakeholder groups. However, these systems might also be used only by managers/employers, in order to track workers even more closely. In this case, these systems will reinforce the practice of scientific management 2.0. (Schildt, 2016). Overall, the researcher denotes the upcoming digitalization of management in the following decades. Its impact on organizational structure and roles is yet to be explored.

Jarrahi (2019) also focused on AI-systems and how they can transform work dynamics in organizations, building his discourse on Zuboff's theory of computerization and automation. Even though this theory was developed in 1988, its propositions are still considered to be relevant (Jarrahi, 2019). Zuboff's theory postulates that AI machines can be used for *automating* work, when they are in charge of performing it, and for *informating* work, when they provide information and help

to form a more complete perspective on organizational processes. These two types of applications are quite similar to Shildt's (2016) types of AI systems, only the background theory choice was different in this case. The similarity was also present in both researchers' conclusions, as Jarrahi (2019) also pointed out the inevitable Taylorisation and digitalization of scientific management practice, if the work is fully automated by AI-systems. To explain this point of view in more detail, when the workers are constantly monitored by the system, there is a chance that their sense of autonomy will decrease, and then work processes will resemble Taylor's strict rules- and standards-based labor management, along with hierarchical organizational control. In such context, workers will have low negotiating power and it might lead to their de-skilling and demoralization (Jarrahi, 2019). Moreover, both Jarrahi (2019) and Schildt (2016) emphasize the plausible effects of using AI-powered systems to provide information and insights on organizational processes, because it will provide a possibility to create a more democratic organizational culture, imposing the scenario, where everyone has more or less equal access to information.

Faraj (2019) is another researcher, who discussed the implications of AI for organizational design and what changes it might bring. He outlined several possible outcomes that are likely to happen if management becomes algorithmic:

- Authority over decision-making process will shift from human managers to algorithmic systems, what might change the present management roles and established practices.
- The management process will become less social, due to the automatic implementation of decisions and no possibility to discuss them between managers and employees. This might lead to a clash of perspectives, if the expert opinion of workers is different from the one imposed by the system, which is limited by data and lacks in intuition (Faraj, 2019).
- Loss of the autonomy at work is considered to be a likely outcome as well, which is in line with the views of Jarrahi (2019) and Schildt (2016). The lack of transparency behind the algorithmic decisions will also contribute to reducing the sociality at work, because the management decisions might not be understood by subordinates and it would be impossible to discuss and negotiate them.
- One dilemma will be weather those professionals, whose work can be delegated to algorithmic systems, will be fully replaced or just assisted by technology.
- Another unknown issue is to what extent the AI will be empowered and how objective its decisions will be considered to be and in which contexts. Will a human manager still hold veto and a right to overwrite them (Faraj, 2019)?

Perception of Algorithmic Management by Workers

The other conceptualization perspective present in the field is focused on **exploring how workers perceive algorithmic management and decisions**, their general experience. This body of research aimed at studying and formulating the "inside" perspective on the phenomenon and includes papers by Lee, Kusbit, Metsky, and Dabbish (2015), Lee (2018), Möhlmann and Zalmanson (2017), Bing, Hengchen, Zhang D., Zhang F., and Haoyuan (2020), Jabagi, Croteau, and Audebrand (2020), Wiener, Cram, and Benlian (2019).

To open the discourse, Lee et al. (2015) were the first in the field to begin the discussion on algorithmic management and to study how eagerly workers cooperate with algorithmic systems, how motivated they are to work, how effective the practice is overall and from the workers perspective, in particular. The researchers tried to conceptualize the topic in the context of HCI and computer science. Through multiple interviews with drivers from Uber and Lyft, they discovered that the effectiveness of the whole practice is very much dependent on how fast the drivers respond to requests and how frequently they do it, because it maximizes the number of passengers getting the ride. Their findings revealed that communication of the assignment and its details, short time spans to accept it and the presence of the individual acceptance rate for each worker (which determines how many assignments he will be getting in the future) together contributed to how cooperative they are (Lee et al., 2015). The researchers also suggested that one of the possible solutions an increase in cooperation and motivation of the drivers can be achieved through the increased transparency of the work assignment process and reasoning behind it. They build their assumptions on the fact that the lack of information on the task and inability to get explanation, often leads to assignment rejection by workers, as they either perceive it as a system error or feel like they know better, if they are experienced. More studies on transparency in the algorithmic work context are presented and discussed in the following 5.2.2 section. Another interesting finding of Lee et al. (2015) was that the majority of the drivers did not desire to have more control over the system and more flexibility to choose between the tasks.

Later on, Lee (2018) continued to explore how workers perceive the decisions of algorithmic versus human managers and, more precisely, what determines how fair they will consider them. The study uncovered that the nature of the task itself – weather it is more *mechanical* (work assignment and scheduling) or more *human* (hiring and evaluating), - greatly affected workers' trust and emotions towards it, along with their perception of fairness. For mechanical tasks, the perception of decisions was the same, no matter if it was assigned by an algorithm or a human, it was still considered to be fair and the emotions of workers were the same towards both (Lee, 2018). However, the reasoning behind it was different, depending on who was the assignee. In the case of a human decision-maker, subordinates attributed the fairness of the decision to his authority and considered social recognition to be one of the factors, which could reinforce it. In the case of the algorithmic decisions, the fairness was attributed to the lack of bias and reliability of the system, with the note

that when the system is assisting rather than controlling, it would positively affect the perceptions of its decisions (Lee, 2018). When the more human tasks (evaluation and hiring) were concerned, most of the workers considered decisions made by algorithms as less fair and trustworthy, and felt rather negative towards them. The reasoning behind it was that computers lack human intuition and are unable to handle the exceptions and social interaction, so cannot judge a person (Lee, 2018). The background theories mentioned Zuboff's automation theory (like in Jarrahi's study, 2019) and also other ones which explore the adoption of automation technologies (but different from those in Wesche's and Sonderegger's study, 2019).

Bing et al. (2020) also contributed to the research on the perception of fairness of algorithmic decisions at workplace. In their experimental study on factory workers of Alibaba Group, they discovered that when the task was assigned by an algorithm, the perceived fairness was higher, even though the assignment procedure followed the same underlying rules, no matter if it was executed by a machine or a human. The researchers believe that the labor-intensive context could determine that workers were seeking the equality rather than personalization of the process and could consider a machine to comply with the rules more consistently that a human (Bing et al., 2020). The other finding was that the task pick-up rate was also higher in the case of an algorithm to be the assignee. Bing et al. (2020) note that these effects (higher productivity under algorithmic decision-maker) were especially prominent in the case of workers, who were usually upset by getting difficult tasks and by those with higher education.

Möhlmann and Zalmanson (2017) were among the same group of researchers, who explored the organization of work under algorithmic management and how workers perceive it, but they did it in the context of Information Systems (IS) management. The researchers discovered that, in case of Uber drivers, workers perceive themselves as autonomous – they have flexibility in working hours (no fixed shifts) and no direct supervisor to report to, they do not interact with other drivers and do not feel being part of the organization either, not sharing its values and goals (Möhlmann & Zalmanson, 2017). Additionally, the researchers outlined several characteristics of algorithmic management that they have determined during the study: *constant tracking* (where the drivers are, who they ride, all transactions), *constant evaluation of the performance* (customer ratings plus location tacking data and number of rides), *automatic implementation of the decisions* (penalties, e.g., shut-down or ban), *working with the system* (no human communication and support), *low transparency* (limited access to information and knowledge of system's logic). One of the main findings was the power asymmetry, which drivers experienced through the loss of autonomy and control (e.g., when they perceived the decision as unfair, did not have access to information behind it and could not contact anyone to ask), what resulted in strain for many workers. As a consequence, to regain the control, workers guessed the system (e.g., exchanging the knowledge through forums), resisted it in various ways (e.g.,

turning off location tracking, rejecting suggested tasks), attempted to game it or switched it completely (to other platform providers) (Möhlmann & Zalmanson, 2017).

Building on these findings and conceptualization of Möhlmann and Zalmanson (2017), Jabagi et al. (2019) advanced the perspective of workers' perceptions further, creating a framework of Perceived Organizational Support in the context of algorithmic management. They took the five attributes of algorithmic management (by Möhlmann & Zalmanson, 2017) and the prior studies on workers' perceptions of autonomy and fairness in this context. Based on the general theories on POS and HCI, the researchers outlined the model of factors, which contribute to the perceived organizational support of the workers, when the management is algorithmic and there is no human support (Figure 9) (Jabagi et al., 2019). One of the main conclusions of their study is that autonomy is a crucial component of the satisfaction of workers under algorithmic management, so one of the ways to reinforce it on organizational level is to provide them with more transparency of the system and its decision-making process. Jabagi et al. (2019) still note the high importance of a "human element" for evaluation and support functions in the algorithmic management context.

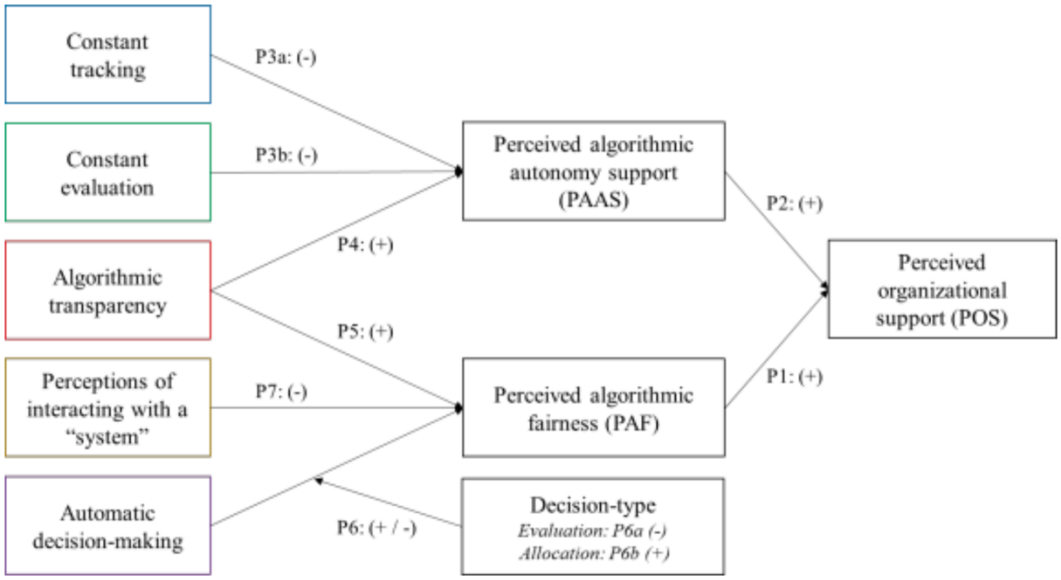


Figure 9. Conceptual framework of Perceived Organizational Support in algorithmic management (Jabagi et al., 2019).

Contrasting with the perspectives discussed so far, Wiener et al. (2019) wanted to reconceptualize the topic within the IS discipline and addressed the phenomenon as a type of Technology Mediated Control (TMC) (defined earlier in this chapter), where the technology is used to either support human management or to automate it (algorithmic management). In their conceptualization, the main notion was that in both types of TMC there is still an organization behind the system and, thus, the management of work processes, to a certain extent. With this in mind, they explored how legitimacy is perceived, when the management/control is mediated by

technology. In other words, how appropriate each worker considers the actions of an organization (to guide them in their daily endeavors) in the context of TMC (Wiener et al., 2019). First, they identified three attributes, which directly contribute to the perception of TMC legitimacy – autonomy (ability to work independently), fairness (of control and decisions) and privacy (who receives personal information and how it is used). These attributes constitute the actual work experience under TMC, this is why they directly affect the legitimacy perception. However, other factors included – input control of the platform (when a worker provides information to get accepted), output control (external feedback on the system), behavior control (personal improvement suggestions provided by the system), self-control (how much the workers are in control of their life and goals) and clan control (shared goals and vision with a group) (Wiener et al., 2019). Besides, background of the worker itself (part-time/full-time, experienced or not, attitude towards gamification, high/low income, etc.) and platform characteristics (degree of control over workers, high or low skilled work, degree of gamification) also contributed to the overall perception of the TMC legitimacy (Wiener et al., 2019). This perception, in turn, leads to different outcomes, for instance, to continuation or termination of worker's stay on the platform, as well as weather he will comply or violate the existing control policies.

Platformic Management, Sharing Economy & Other Perspectives

Another camp of researchers represents those, who approached the topic from the perspective of platformic management, sharing economy and gig-work, not mentioning or focusing directly on the algorithmic management as a stand-alone practice. Some of the researchers, who explored the issue from this perspective are Sutherland and Jarrahi (2018), Altenried (2020) and Jarrahi, Sutherland, Nelson and Sawyer (2019).

Sutherland and Jarrahi (2018) discovered the recent emergence of the concept of **"sharing economy"** and decided to study it in more detail by conducting a literature review, in order to formulate an understanding of its current presence in the research field. Basically, the term sharing economy is rather self-explanatory, the only thing is that it is enabled by means of technology. The researchers, however, note that the studies on this "technology", which stays at the core of sharing economy, are rather scattered, happen across different disciplines and, above all, does not have an agreed term usage to address it. Some are using the word "algorithm", some "platform", while many just say "technology" (Sutherland & Jarrahi, 2018). The study aimed at conceptualizing the topic of sharing economy with an emphasis on technology behind it. The keywords the researchers used for the study did not include "algorithmic management" or anything with "algorithm" or "automation". The most commonly referred platforms in literature on sharing economy were Airbnb (21% of publications), followed by Uber (19%) and Amazon (11%) with other platforms of less than 5%. The major finding of the review was that most of the literature on the topic

(42.5%) either did not address the technology issue at all or just mentioned it as "technology", not defining it or its characteristics (Sutherland & Jarrahi, 2018). The researchers divided the present body of literature into two categories. One focused on centralized platforms or, in other words, on centralized model of mediation in sharing economy, where there is a strong authoritative presence of the "technology" in the interactions and exchanges between the platform participants (focus areas: surveillance, control, algorithmic management). The other part of literature focused on decentralized platforms, which mostly served for matchmaking. The studies in this category focused on rather humanistic issues (e.g., altruism, sustainability) than on embedded technology of the platform (Sutherland & Jarrahi, 2018).

Jarrahi et al. (2019) were the ones to advance further the concept of "platformic management" and, most importantly, to distinguish it from algorithmic management. In their study, the researchers focused explicitly on Upwork platform, which has certain distinguishable features in terms of how the work is organized, compared to other platform-enabled labor types (e.g., on Uber or Amazon Turk) and, thus, have different management mechanisms as well (Jarrahi et al., 2019). In the background theories for their conceptualization, the researchers explored the literature on algorithmic management, its key attributes and work challenges it embodies. As the outcome of the study, they have identified six main functions of **platformic management** in the context of knowledge-intensive labor platforms, which were the following: management of transactions (structuring plus automation), channeling of communications (not under control of algorithmic management), conflict resolution, information supply (best matches from algorithms and general guides), performance evaluation (integrated client plus algorithmic measure) and gatekeeping (policies and restrictions). The researchers come to an interesting conclusion that these practices of Upwork platform are, in fact, resembling many roles of human managers (e.g., resource allocator, liaison, as described in Chapter 2.1.2), what is not present within algorithmic management and is, thus, a different concept, which the authors define as platformic management (Jarrahi et al., 2019). To elaborate, on the Upwork platform, the communication between workers and clients is frequent, evaluation of work is a multi-staged and complex, while the performance tracking (platformic control) happens through input of hours and diary entries of workers, unlike, for instance, plain location and time stamp data analysis on ridesharing platforms. Plus, even though the knowledge-labor platform providers also have control over data, as in algorithmic management, what creates power asymmetries for the workers, on Upwork they, actually, have the power to negotiate with clients and go around the platform policies, what, as a result, restores some of their lost power (Jarrahi et al., 2019).

Altenried (2020) explored the phenomenon from the perspective of **crowdwork labor** (also addressed as platform or digital labor) and its catalyzation of digital Taylorism (in line with some of the perspectives discussed earlier), where the technology enables new methods of surveillance, standardization and disintegration

through fully or partly automated (algorithmic) management, control and cooperation. The article focused on the identification of elements that are similar to those outlined by Taylor, but in the context of crowdwork and/or platform work with possible deviations. According to Altenried (2020), such working aspects as specific and constant measurement and surveillance by technology, along with strict behavior rules employed on the platforms are direct examples of Tailorization. However, unlike the traditional scientific management and Ford's factory management, there is no homogenization of the workers within the contemporary version of digital Taylorism, because people working on these platforms are diverse and they also work differently. Nevertheless, the overall infrastructure of the production on these platforms and the socio-spatial functions organization are similar to the traditional factory and, thus, can be perceived as a digital factory (Altenried, 2020). The researcher did not distinguish between different platform types by the nature of tasks or any other basis. Algorithmic management is mentioned as one of the practices present in the context of crowdwork.

Duggan et al. (2019) were among the first in the field of HRM to point into the direction of exploring the organization of HR practices within gig work and in algorithmic management. In order to bring more clarity into the existing platforms and work on them, they outlined their own distinction between different types of employment and platform-based work (Figure 10).

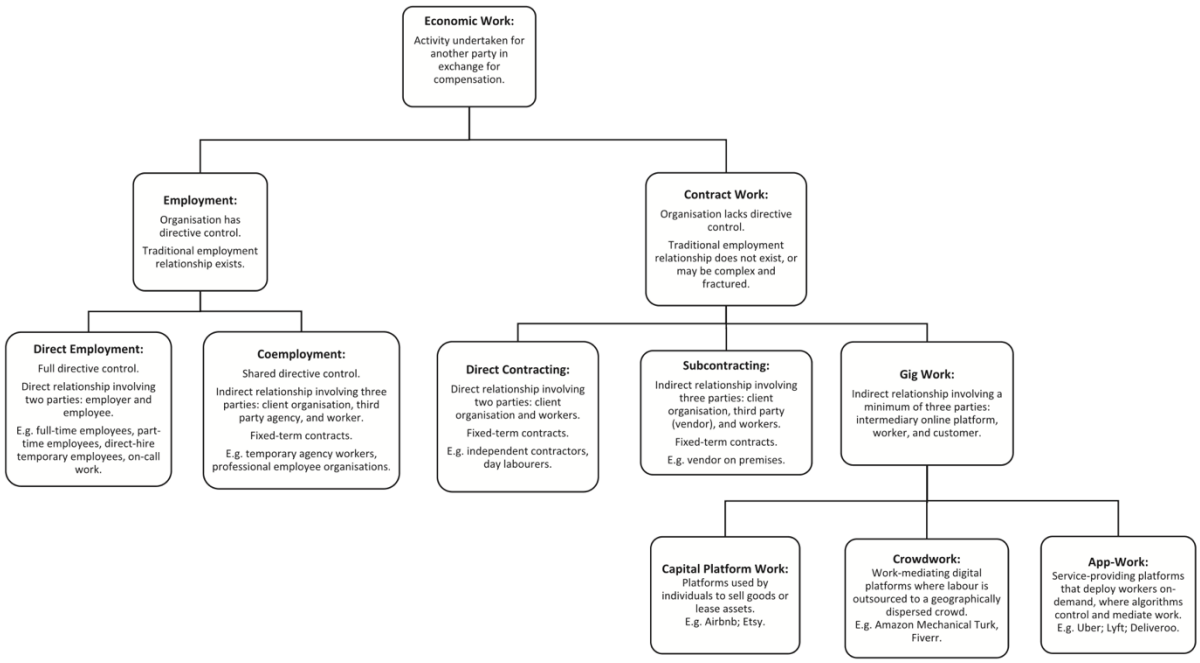


Figure 10. Types of work arrangements, employment, contract work and gig work (Duggan et al., 2019).

Gig work, being an example of contract work, was divided into three categories – Capital platform work (e.g., Airbnb, Etsy), Crowdwork (e.g., Amazon Mturk, Upwork) and App-work (e.g., Uber, Fodoora). *Capital platform work* can be described as a digital platform for selling the goods peer-to-peer, where the role of the platform

is to connect the customers with certail resources (form of capital) offered by individuals. A distinctive feature of these platforms is that there is no actual "work" executed by anyone, but the underused resources or assets are shared in a way between the owner, the customer and with the platform, making it an asset-based-service (Duggan et al., 2019). These platforms are often related to "sharing economy" and "algorithmic management" within research, even though they represent a totally different practice and a way to earn money. *Crowdwork* the researchers considered to be representing those platforms, on which a task or project is completed by workers remotely, but through the platform. The researchers note that crowdwork could be broken into even smaller categories: cloud-based work (task completed remotely), crowdwork (task is given to a group of people online), micro-tasking crowdwork (when a certain task is broken into sub-tasks) and contest-based crowdwork (when the work is completed by a large group simultaneously, but with one result, which is being accepted and paid). *App-Work* is defined as a type of gig work, where an intermediary service-providing organization (in a form of a digital platform) utilizes workers for providing services locally (e.g., ridesharing or delivery), taking a percentage from each completed task. The researchers pointed out the role of algorithmic management in the context of app-work and explored the functions of human resource management that have been mediated by technology in this context, also mentioning the resemblance of Taylor's and Ford's approaches to management. The researchers explain that, according to the organizational support theory, employees perceive HRM practices (e.g., performance management and work assignment) as determinant of organization's commitment and support, so in algorithmic management, where these practices are automated and oblique for the workers, their perceptions might drift towards negative (Duggan et al., 2019).

5.2.2 Critique of Algorithmic Management

A big portion of the material was dedicated to exploring and identifying the problems of algorithmic management from various perspectives (e.g., HRM, labor law, power). As could be noticed from the reporting of the material up to this point, the perspectives of research to explore a certain issue in the field vary quite much. The same applies to the studies of the problematic conditions and issues of algorithmic management and platform-based work. They are interdisciplinary and have been explored from labor law, HRM, ethics and other perspectives. The material is presented in this subchapter. The articles, which explicitly focused on criticizing platform-based employment and the conditions of work and labor in online labor markets are presented in Table 7.

This subsection explores the research question: What are the problems of algorithmic management discovered and discussed in research so far? Besides, the section also discusses the papers, which provide the solutions or improvements to

some of the discussed problems of these systems and the work under such management processes.

Author(s), year	Title	Contribution
Gal, Jensen & Stein, 2020	*Breaking the vicious cycle of algorithmic management: A virtue ethics approach to people analytics.*	Studies ethical challenges of algorithmic management, which lack in the field.
Mateescu & Nguyen, 2019	*Algorithmic management in the workplace.*	Highlights four main problems of algorithmic management for workers.
Connelly, Fieseler, Černe, Giessner & Wong, 2020	*Working in the digitized economy: HRM theory & practice.*	Points out the missing elements of human resource management within algorithmic environment.
Duggan, Sherman, Carbery & McDonnell, 2019	*Algorithmic management and app-work in the gig economy: A research agenda for employment relations and HRM.*	Finds the differences between the traditional human relationship management and its role and design within algorithmic management environment.
Mengay, 2020	*Digitalization of work and heteronomy.*	Demonstrates how workers lose their autonomy in algorithmic management.
Munn, 2018	*Rendered Inoperable: Uber and the Collapse of Algorithmic Power.*	Uniquely showcases how algorithmic management systems influence and change workers' behavior.
Pastuh & Geppert, 2020	*A "Circuits of Power"-based Perspective on Algorithmic Management and Labour in the Gig Economy.*	Demonstrates how the power of algorithmic management over workers is executed and results in unfavorable work experiences.
Kaine & Josserand, 2019	*The organisation and experience of work in the gig economy.*	Highlights legal problems and risks in algorithmic management for workers.
Cheng & Foley, 2019	*Algorithmic management: The case of Airbnb.*	Studies the experiences and reactions to algorithmic

		management in an unusual context (Airbnb).

Table 7. Articles, which focused on the present problems of algorithmic management.

Human Resource Management (HRM)

Researchers, who explored the problematic issues of algorithmic management from a Human Resource Management (HRM) perspective, were Connelly, Fieseler, Černe, Giessner and Wong (2020) and Duggan, Sherman, Carbery and McDonnell (2019).

Duggan et al. (2019) not only made a distinction between the types of platform-based work (figure 10, p. 61), but also focused their study specifically on the app-work and algorithmic management. The researchers explicitly state that, even though such functions of human resource management as work assignment, performance management and employment relationship building are present in app-work, they are totally different from the established known models of HRM, from both their strategic planning and implementation perspectives. Taking the ***employment relations***, in algorithmic management context they are of purely transactional nature, as no effort is put into the development of trust and commitment of workers. Besides, the training and competence development opportunities are nonexistent in app-work, as well as social interactions and networking opportunities (Duggan et al., 2019). In app-work, platforms regulate workers based on certain rules and affordances, making them both dependent and limited in their work, what also makes it clear that the power dynamics are not balanced, shifting towards the platform (constant control and complete authority over decisions) and customers (anonymous ratings), creating digital Taylorism experience. Additionally, well-being of workers is significantly damaged, as no social or security benefits are provided (Duggan et al., 2019). When it comes the ***work assignment*** practice itself, it is very opaque and, as the evidence shows, usually works in favor of more efficient and fast workers. Besides, the autonomy of workers to choose whether to pick a task or to work in general, which is claimed to be one of the benefits, is under a big question, because all the rejections and delays are monitored, recorded and affect (negatively) any further tasks proposals for an individual worker, thus, limiting his autonomy. Lastly, the ***performance management*** is also associated with the lack of transparency behind it and relies purely on quantitative measures, not taking into account any behavioral nuances and controversial situations, even though multiple parties are involved and affect the final ratings (Duggan et al., 2019).

Another critical HRM review was conducted by Connelly et al. (2020), who identified several challenges of the traditional human HRM practices within the context of gig economy. They pointed out that, for example, workers retention and engagement normally involve such practices as an establishment of qualified relationship with supervisor, meaningfulness of work from which the benefit for society and others is visible for the worker, team spirit and activities, training and

professional development. However, they are hardly present (and not likely to appear any time soon) within the algorithmic management. Many of this kind of practices are not present on the digital labor platforms, because workers are not officially considered as employees there, but are, instead, independent contractors (Connelly et al., 2020). Having such employment status and freedom over the schedule and completion of the tasks, prevents HR department from employing activities targeted on increasing the engagement of workers, in order to achieve higher productivity and performance quality rates. Thus, in gig work, HRM could be (and often is at present) focusing only on transactions management and accounting, general monitoring of workers, their status and differences, matching the supply and demand, recruitment, as well as suggesting when the full-time employee would be a better choice than gig worker. In terms of performance management, the researchers note that if algorithms are used instead of the HR managers, then transparency of the data usage is required, so that employees are able to know how their personal data is used and are can argue with that. Besides, HR department should be the one accountable for the technology usage. However, as in gig economy workers are not employees, these practices are not in place either (Connelly et al., 2020). Considering the compensation and benefits side, it is normally managed though the "gamification" of the system in gig work and is relatively effective, because the performance metrics of each worker are easily monitored. Nevertheless, the overall design of the job should be targeted on being highly motivating, because the workers' engagement cannot be encouraged by human managers within the algorithmic management setting (Connelly et al., 2020).

Power in Algorithmic Management

Several researchers explicitly addressed the problematic issue of power within algorithmic management, in particular, Munn (2018) and Pastuh and Geppert (2020). Pastuh and Geppert (2020) reviewed the existing studies on the power dynamics in algorithmic management, based on which they developed a "circuit of power" model, which they applied on algorithmic management (Appendix 2). The researchers identified five main mechanisms that are present in algorithmic management and directly affect the workers. They were the following:

- Formal mechanisms, like algorithmic bureaucracy and digital Taylorism (e.g., suggested work templates and rules accepted automatically by joining the platform)
- Direct control mechanisms of customers over workers (e.g., through rating system)
- Incentive mechanisms to match supply and demand (e.g., higher pay rate areas)
- Internal communication of the platform provider, based on having access to more data, represents informal mechanisms (e.g., push notifications, go-to-work encouragements)

- Through the informal mechanisms, subtle influence mechanisms emerge, as behavioral economics suggest (e.g., nudging, persuasive app design, gamification by achievements) (Pastuh & Geppert, 2020).

These mechanisms cause certain problematic experiences. For example, workers operate under constant surveillance and are penalized straight away for any unwilling behavior by the algorithmic systems. These consequences, along with the general lack of information behind platform's decisions, make them to accept even the unfavorable orders. Gamification can also contribute to this, as it might influence drivers on psychological level (e.g., like gambling). Besides, income targeting and performance tracking practices might lead to working longer hours, despite no guarantee of higher profit. There is also no opportunity to negotiate the employment conditions, when they are changed against workers benefit. The absence of the formal legitimate authority representatives is considered to be the major drawback of the algorithmic management (Pastuh & Geppert, 2020).

Munn (2018) studied the phenomenon of management by algorithms in Uber systems, determining three technical practices – encapsulation, enlistment and enchantment, - through which the power is applied to the workforce which are also limiting it in several ways. *Encapsulation* is referred to the beginning of the driver's work on the platform, meaning that, basically, when each driver joins the platform and accepts all the terms, he is automatically encapsulated and given certain parameters and functions within the platform, not accounting for any cultural or personal differences (Munn, 2018). *Enlistment* stands for the process of matching the drivers with those requesting a drive. Ideally, each request should be picked up by a driver, who also provides the service, and does everything in a timely and professional manner. To facilitate this process, Uber system sends drivers timely messages, gamifies missions, offers promotions and city campaigns, gives notifications of better income areas. However, not accounting for any personal and local differences of drivers, these facilitative pulling practices of algorithms fail to be effective in the end, leading to high turnover rates (Munn, 2018). *Enchantment* represents a complex operation, when a system forces a subject to accommodate with it. In other words, since every system is limited in terms of its behavior evaluation possibilities, it compensates for it by establishing more straight forward and strict performance measures (customer ratings plus tracking). This makes the subordinates "enchanted", because they not willingly accept "the rules of the game" and adjust their performance in a way, which can be recognized by the algorithms. What it means on practice is often referred to as "affective labor", when workers suppress their feelings or induce, for example, positive ones in customers, basically, collaborating with the algorithmic system. It can be a simple handshake or an offer of a bottle of water, but as it has to be jolly and improvised to be effective, it makes it impossible to put into code (Munn, 2018). From the overview of these practices, the author concludes that notable power is constantly executed through the technical operations (encapsulation, enlisting and enchantment), which are based on the implications of

algorithmic boundaries. However, in some situations, this power is easily lost, when these operations are found unnecessary and are not followed by the workers.

Organization and Experience of Work

Contributing to the criticizing discourse on algorithmic management, Kaine and Josserand (2019) performed a literature review on workers' experiences in gig economy, also conducting a keyword analysis within the discovered literature (note: "algorithmic management" was not among their search keywords). The researchers discovered that one of the key themes was the employment status of gig workers (independent contractors versus direct employees). Basically, work in sharing economy or gig economy is usually contract-based and this causes many problematic experiences for the workers. Starting from the lack of awareness on their contract status, workers are also unable to negotiate any changes done to their work conditions, as the platform provider has right to change them any time, not being concerned by labor laws and unions (Kaine & Josserand, 2019). In most cases, gig workers are not provided with any health, training and security benefits. Thus, many risks associated with their work concern health and safety, as well as the insurance of their own assets (e.g., a car in Uber) and the possibility to be deactivated from the platform without much delay. Another revelation was that workers in gig economy do not earn as much as those, who are permanently employed, even though they are working for longer hour (Kaine & Josserand, 2019). There is a poor or almost no legal regulation of this type of work, since the workers are considered to be "self-employed" or "entrepreneurs" with an emphasis that it should be developed, as the workers are taking direct risks at work. Regarding workers' experiences of work on the platform, the anxiety and negative emotions were among the problems of many, partly due to the poor communication with platform and handling of the issues. Information and power asymmetries, favoring the platform and algorithmic management, were also highlighted by many in the research field on gig work (Kaine & Josserand, 2019).

Mateescu and Nguyen (2019) in their explanatory review on algorithmic management, outlined four key problematic areas, in which workers' rights have been neglected to a certain extent, mainly due to the technological nature of the practice. Constant ***surveillance*** and control represent one of them. Working in such conditions, knowing that all your performance data is collected and analyzed by the system, imposes additional pressures on workers, limits their personal discretion in the decision-making process and does not account for any critical situations incurred at work. The other problem emerges from a lack of ***transparency*** on how the algorithms operate, creating additional challenges for the workers to figure out the logic behind decisions, even regarding their salary calculation (Mateescu & Nguyen, 2019). Another source of anxiety is the actual customer rating system, which poses a threat of ***bias and discrimination*** in performance evaluation. Algorithmic management, in

its turn, serves as an excuse for the problematic issues like this, which platform owners use to avoid being ***accountable*** for the effects of their organizational decisions, not revealing the logic behind the technology either (Mateescu & Nguyen, 2019).

The problems summarized by Mateescu and Nguyen (2019) have been supported and mentioned by many in the field. For example, the surveillance is highlighted by all, who compared algorithmic management with Taylor's scientific management theory, along with some other researchers in the field – Jarrahi et al. (2019), Möhlmann and Zalmanson (2017), Jarrahi and Sutherland (2019), Mengay (2020) and Altenried (2020). The main issue of surveillance is that it undermines the sense of *autonomy* of workers, which is promised to them by platform providers and also as a benefit of not having a status of traditional employee (e.g., Möhlmann & Zalmanson, 2017; Mateescu & Nguyen, 2019). Transparency and accountability aspects of algorithmic systems used in management of people has also drawn much attention of the researchers. The literature on the topic is presented in a next subchapter. Bias and discrimination of algorithmic systems were found to be among the key problems in, for example, Vallas and Schor (2020) literature review on the topic of platform work and were also mentioned by Jarrahi and Sutherland (2019).

The aspects of autonomy and control were at the core focus in the study by Mengay (2020) on the digitalization of work. The researcher mentioned that autonomy is often used interchangeably with self-determination and self-governance, basically reflecting the freedom over own decisions at work and its organization. The main conclusion was that even though digitalization of work often promises more freedom for workers, on practice there are at least three factors in place that produce the opposite effect of heteronomy: flexible structures, formalization and decision-making centered on data (Mengay, 2020). By flexible structures the author means the flexibility of work arrangements (e.g., time, place, amount), which is advantageous on practice only for those, who have more power. Thus, as an outcome, the work can be given to only efficient (according to data) workers and, in this case, its distribution is easily delegated to algorithmic systems, making workers to lose their autonomy by being strictly evaluated. Digitalization also leads to the formalization of work processes, as all control and measuring mechanisms become computerized, channeled and unified, and must be strictly complied with. Data-driven (and automatic) decisions lower the autonomy of workers, as they are not anyhow under their control, as well as understanding, making it impossible to criticize and negotiate management decisions (Mengay, 2020).

Gal, Jensen and Stein (2020) are the only ones within the literature sample, who have approached the analysis of algorithmic management and, as they also address it, people analytics, from the perspective of ethical challenges that the practice contains. The researchers explored the concept of virtue ethics or virtuous action and what are the elements that need to be present for people to act virtuously. The main findings revealed that three main problems of algorithmic systems – opacity, datafication and nudging – turn out to be workers' virtue underminers, as they limit their ability to

pursue own goods, to acquire practical wisdom and to act voluntarily. Workers do not get constructive feedback and, thus, do not know how to improve (Gal et al., 2020). They cannot properly socialize with organization and are unable to develop the understanding of underlying principle behind its decision-making. Moreover, they are unable to see their contribution to organization and to reflect upon and revise their assumptions and actions. Nudging and manipulation of these systems also results in the inability to pursue personal outcomes for the workers. It also reduces a possibility for analysis of own actions and understanding "why I acted so and not otherwise", losing the own meaning and explanation to oneself. Gal et al. (2020) provide a clear overview of the ethical issues that affect employee's behavior and their pursuit of virtue at the workplace, when people analytics and algorithmic management is in place. All the three elements – opacity, datafication and nudging – prior to these systems, create a vicious cycle, in which each of them reinforces the other one. One possible way organizations can escape this happening is to frame the technology differently – as a fallible companion, adding new human roles and transforming algorithmic management into a hybrid practice. Designing the algorithmic systems to inform the ambiguity, not to create it.

There is one outlier within the literature, an article by Cheng and Foley (2019) on algorithmic management in Airbnb. It is an outlier, because the researchers do not take into account previous conceptualizations of algorithmic management (addressing Airbnb hosts as "labor force") or taxonomy and distinction of platforms within sharing economy (e.g., Jabagi et al., 2019; Duggan et al., 2019; presented and discussed in chapter 5.2.2), bringing controversy in the research fields. Nevertheless, as the main focus of their study is the experience of operating under algorithmic management, it was included in the review to provide the full perspective on the issue. The unpleasant elements of algorithmic management mentioned by Airbnb hosts were *algorithmic ambiguity, sense of anxiety, sense of external control, penalties*. These, in turn, triggered the hosts to *experiment, manipulate and resist* the system's algorithmic decisions. In their study Cheng and Foley (2019) also discovered that hosts were questioning the validity of algorithmic decisions, what prevented them from adopting and following them. The researchers assume that this could lead to the loss of the organizational credibility of sharing economy organizations. Overall, the problematic issues discovered are in line with other studies on the topic of, for instance, Lee et al. (2015) and Rosenblat and Stark (2016).

Trust and Transparency

Author(s), year	**Title**	**Contribution**
De Laat, 2017	*Algorithmic Decision-Making Based on Machine Learning from*	Argues that making algorithmic management

	Big Data: Can Transparency Restore Accountability?	systems transparent for the users is also a big challenge.
Glikson & Woolley, 2019	*Theoretical Framework for Understanding Human Trust in Artificial Intelligence.*	Provides a framework of required human trust towards different AI agents.
Lee, Jain, Cha, Ojha & Kusbit, 2018	*Procedural Justice in Algorithmic Fairness.*	Presents insights on how users perceive algorithmic decisions, depending on the degree of transparency of the decision-making process.
Lee, Kusbit, Metsky & Dabbish, 2015	*Working with Machines.*	Proposes that transparency could be a solution to improving workers' experience under algorithmic management.

Table 8. Articles, which focused on the transparency of the algorithmic systems and decisions.

Transparency can be defined as a feature of the system, which gives users opportunities to see how decisions are made, to evaluate decisions' outcomes and the decision-maker itself (Lee et al., 2018). The issue of transparency being one of the main possible solutions to improve the overall experience of work under algorithmic management was mentioned already in 2015 by Lee et al., when they first introduced the phenomenon and set the stage for further research in the field. In their article, the researchers proposed that by making the algorithmic management processes more transparent, the performance and commitment of workers could increase, as well as their trust and general attitude towards the company could be improved. It is interesting to see that there have been several studies on algorithmic transparency, but their findings vary.

Glikson and Woolley (2019) developed a unifying framework for understanding human trust towards Artificial Intelligence in management, integrating the findings of the existing studies across different research disciplines. They took an AI embodiment framework, which represents a continuum of AI presence – from no identical presence (embedded or hidden), to virtual (voice or image/text agent, e.g., Siri) and physical (robots, automatic cars). Then, the researchers defined three types of roles that AI agent can have within management and in interactions with users, with a different level of control in each case: a tool (human controls the process), an assistant (shared control) and a manager (technology is responsible for the high-level decision-making, decides on what has to be accomplished by humans) (Glikson & Woolley, 2019). Due to the fact that in most cases users of the technology are not involved in and dedicated to its development

process, they have a low level of understanding of its competence and reliability, what adds more weight to the importance of their trust towards it. As can be seen from the Figure 11, in case when technology has a role of a manager, despite the type of its embodiment, high emotional and cognitive trust from a human subordinate is required, in order to ensure the compliance with algorithmic decisions (Glikson & Woolley, 2019).

Level/ Type of Representation	Level of Machine Intelligence: Tool	Assistant	Manager
Physical	Lowest emotional and cognitive trust	Medium emotional and cognitive trust	Highest emotional and cognitive trust
Virtual	Lowest emotional trust	Medium emotional trust	Highest emotional trust
Embedded	Lowest cognitive trust	Medium cognitive trust	Highest cognitive trust

Figure 11. Trust at different representations and embodiments of Artificial Intelligence (Glikson & Woolley, 2019). Note: grey areas need more research.

The main findings of Lee, Jain, Cha, Ojha and Kusbit (2018), where they have conducted an experiment of making an algorithmic decision-making process fully transparent, revealed that when people know the inputs (their own data that goes into the system) and the outputs (final decisions) of algorithms, it helps them to understand their own role in and responsibility for the final decision, instead of making the system to be fully accountable for it. Additionally, the results showed that when people see the overall distribution of the results (inc. those of others), it makes the judgement of the decision's fairness easier for them. One controversial finding was that providing a user with full transparency of the decision-making process without giving him control over the outcomes, did not lead to a fairer perception of the results. While when the participants had control over the outcome, they always perceived the decision as fair, no matter if they changed it or not (Lee et al., 2018). Still, the results of the experiment showed that standards clarity (communication of the methods and logic of the decision-maker), together with the outcome (decision's result) explanation enabled people to judge the fairness of the decisions, based on their own fairness concepts, making a transparency to be a necessary component of formulating this perception.

De Laat (2017) carries on a discourse on transparency of autonomous decision-making systems, which utilize big data and machine learning (ML) algorithms to the

publics and users. He comes to a conclusion that the disclosure of, for example, ML logic might lead to manipulations with the systems and attempts to gamify it (e.g., as already found in the study on Uber drivers by Rosenblat and Stark, 2016). In terms of making the data that goes into them, the privacy violation issues come into play. Lastly, many organizations consider algorithms to be their asset, on which they have property right. Thus, making such complex systems fully transparent is a big challenge, rather than an immediate solution to existing problems caused by their opacity (De Laat, 2017). However, if transparency is granted, but restricted to, a certain body of people, who should be responsible for calling and making them accountable, could, to some extent, improve the perceptions of publics of their decisions.

Other Potential Solutions and Improvements

Author(s), year	Title	Contribution
Vallas & Schor, 2020	*What Do Platforms Do? Understanding the Gig Economy.*	Identify four pathways (within literature) of the algorithmic management development in the future.
Yu, Miao, Chen, Fauvel, Li & Lesser, 2017	*Algorithmic Management for Improving Collective Productivity in Crowdsourcing.*	Researchers develop a special index for workers and an approach to maximize productivity in algorithmic management.
Bokányi & Hannák, 2020	*Understanding Inequalities in Ride-Hailing Services Through Simulations.*	Propose a solution to overcome the present inequalities between workers in algorithmic management.
Schor, Attwood-Charles, Cansoy, Ladegaard & Wengronowitz, 2020	*Dependence and precarity in the platform economy.*	The researchers discover a reason behind workers' job satisfaction in platform work/algorithmic management.

Table 9. Articles, which discuss possible solutions and improvements for algorithmic management practice.

Beside the transparency being one of the possible resolutions for some of the problems of algorithmic management, there were several other improvement pathways that were suggested in literature. The improvement solutions, which were specifically related to communications processes, are discussed in the next chapter.

Vallas and Schor (2020) conducted a literature review, in order to find out the future pathways of platform labor development and algorithmic management regulations, which are at the moment problematic in many ways for the workers, as

mentioned earlier. They discovered several directions discussed within literature. In the first pathway, platform capitalism will flourish, and they will become completely dominant centralized entities, with threatening global data-gathering capabilities. In this case, there will be severe exploitation, surveillance, and even more powerful corporate governance and control (Vallas and Schor, 2020). In the second pathway meaningful regulations will be established by local governments, and platform's, worker's and citizen's interests will become balanced. This scenario is close to reality, as some European countries start to introduce certain regulations and make platforms comply with existing laws. A third possible path forward predicts a closer connection of labor platforms with social media ones, which will put more pressure on platform owners to empower the users, due to more open conflicts and disputes. The last envisioned (and quite possible) path says that platforms will be governed (and even owned) by users, as a result of cooperative action and collective resources, enabling workers to challenge the power position of capitalist firms (Vallas and Schor, 2020).

Schor, Attwood-Charles, Cansoy, Ladegaard and Wengronowitz (2020) present very insightful findings on workers satisfaction under algorithmic management. They discovered that workers are more satisfied, when they have another source of income, beside the one coming from the platform (e.g., Uber). Moreover, in such cases (when platform income is not a primary one), workers experienced not only higher job satisfaction, but also more autonomy, generally higher wages and better working conditions. On the contrary, those, who worked on the platform to make a living and, thus, were dependent on it in that regard, often experienced job dissatisfaction and insecurity. This notion leads to an understanding that platforms, basically, parasitize on traditional employers, who provide security and stability for employees, because there is no need for platforms to take this responsibility anymore, as there always be those, who work on the platform for just supplementary income (Schor et al., 2020).

The researchers Bokányi and Hannák (2020) offer a more technical perspective on potential improvements of algorithmic systems. They find out that, based on prior Uber drivers' interviews, there is an inequality of income rates present between the drivers, because for each worker they are calculated individually. Unlike in regular taxi companies, Uber drivers are limited in their peer communication and are not allowed to compare their rates with each other (Bokányi & Hannák, 2020). This is part of the information asymmetry problem discussed earlier, as the company holds more power and control over the data and its processing. The researchers demonstrate on their simulation example how the inequalities within the system (e.g., income rates between drivers) and overall drivers' blindness over the data, can be overcome through providing more transparancy and control to the drivers, enabling them to make more informed decision. Authors emphasize that introduction of the fairness metric (how exactly the evaluation happens) within the system should leverage trust building between the workers and platform provider.

Another technical solution was introduced by Yu, Miao, Chen, Fauvel, Li and Lesser (2017). They have proposed to integrate a special index for each worker, which

would evaluate his own capabilities and a desire or willingness to work at a particular moment and on a particular task. Based on this Worker Desirability Index (WDI), which incorporates and analyzes the data about worker's reputation, workload and motivation, the task can be more effectively assigned and, as a result, overall productivity of crowdwork increased. The researchers named their algorithmic management optimization approach as Surprise-Minimization-Value-Maximization (SMVM) and it aims to minimize fluctuations in workloads of workers and maximize the overall utility of the processes.

5.2.3 Communication and Motivation in Algorithmic Management

Author(s), year	Title	Contribution
Rosenblat & Stark, 2016	*Algorithmic Labor and Information Asymmetries: A Case Study of Uber's Drivers.*	Discusses problems of communication processes and their design in algorithmic management.
Jabagi, Croteau, Audebrand & Marsan, 2019	*Gig-workers' motivation: thinking beyond carrots and sticks.*	Proposes solutions for improving communications and social interactions in algorithmic systems to motivate workers effectively.
Chan & Humphreys, 2018	*Mediatization of Social Space and the Case of Uber Drivers.*	Demonstrates workers' practical responses to the lack of social communication and information on labor providing platforms.
Toyoda, Lucas & Gratch, 2020	*The effects of Autonomy and Task Meaning in Algorithmic Management.*	Provides interesting findings on workers' engagement and performance at task under algorithmic supervision.
Jarrahi & Sutherland, 2019	*Algorithmic Management and Algorithmic Competencies: Understanding and Appropriating Algorithms in Gig Work.*	Discusses the practice of "sensemaking" developed by workers and their information exchange organization on forums.
Möhlmann & Zalmanson, 2017	*Hands on the wheel: Navigating algorithmic management and Uber drivers.*	On the case of Uber, demonstrates how workers' communications are controlled and limited.

Jarrahi, Sutherland, Nelson & Sawyer, 2019	*Platformic Management, Boundary Resources for Gig Work, and Worker Autonomy.*	Provides valuable insights on communications within one of the platforms, where they are not under control of algorithmic management.
Kaine & Josserand, 2019	*The organisation and experience of work in the gig economy.*	Emphasized the importance of social media for solving workers' lack of social interactions and community in algorithmic management.
Shestakofsky & Kelkar, 2020	*Making platforms work: relationship labor and the management of publics.*	Highlights the emergence of "relationship labor" occupation within algorithmic systems.

Table 10. Articles, which mentioned or focused on the aspects of communication in algorithmic management.

Rosenblat and Stark (2016) are among the pioneers of researchers on algorithmic management and the problematic issues in labor conditions and experience of work under it. In their thorough study on Uber systems and how it navigates the workforce, the researchers discovered that the company utilizes technology to structure unequal labor relationships for its own benefit. The researchers dedicated much of their focus to the problems within communication processes, which happen between the company, workers and customers. There were several issues that they discovered and discussed in their paper. First, workers are unable to reach company representatives – Uber outsources its support, it happens only through email and the replies are lacking situational understanding and are often templated (Rosenblat & Stark, 2016). The motivation of workers happens mostly through the promises of higher pay rates in certain areas and at specific times, for which they get notified. Authors note that this practice of behavioral engagement, which similar to gambling or gaming from the emotional experience perspective, is not often accurate, but is used by Uber to facilitate the relationships between supply and demand. In weekly performance reports the driver's statistics are shown in comparison with top performers, to leverage competitive behavior. Additionally, because of the rating system employed on the platform, workers are often using innovative methods (e.g., offering water) to serve the clients, in order to build good impression and get a better rating. The Uber system also sends them messages with tips on what they can improve to increase their ratings (e.g., professionalism, city knowledge, service) (Rosenblat & Stark, 2016). Among their conclusions was that Uber empowers itself by having the control over most of the information, monitoring workers and trying to engage them by means of gamification, nudging and promising financial incentives. These practices researchers

compare with Tayloristic philosophy to create more efficient workflows, which is in line with many in the field.

Jabagi, Croteau, Audebrand and Marsan (2019) explored the motivation of workers in gig or platform economy, where Information Technology (IT) plays a central role in organizational design and enables the connection between workers and customers. This context is generally known for the lack of social interactions (with colleagues and supervisors), because even human managers, who are traditionally in charge of maintaining and supporting workers' self-motivation, are mediated by technology. In order to tackle this issue, Jabagi et al. (2019) propose for the platform labor providers to integrate Enterprise Social Media (ESM) – "*an organizational web-based platform that facilitates internally facing communication, social interaction and collaboration among users within an enterprise through the creation, sharing and indexing of content* (Leonardi et al., 2013, as cited in Jabagi et al., 2019). Implementation of these platforms should increase the motivation and work satisfaction, fulfilling the psychological needs of the employees. ESM platforms resemble the well-known mass social-media platforms (e.g., LinkedIn), but also have unique functionalities (e.g., wikis, document sharing). They are considered to be very effective for a digital transformation of an organization, because of their ability to facilitate collaboration and knowledge sharing and to enable workers' social interaction, communication, self-expression and better identification of skills and knowledge (Jabagi et al., 2019). By means of these social media tools researchers suggest introducing the practices of *social networking* (e.g., having a profile, share status updates, express opinions, comment) and *social badging* (awards for certain achievements). According to the researchers and their background study of self-determination theory and job design, these features can increase workers' sense of belonging and competence, motivating them to commit and contribute more to their work and the organization.

Similarly, Toyoda, Lucas and Gratch (2020) replicated prior research on self-determination theory of motivation, which postulates that people are most satisfied and productive at work, when they do it for their own sake and enjoy it, rather than when they do it for any external motivators (e.g., money) and under someone's authority. Autonomy represents one of the factors, which plays a key role in facilitating the intrinsic motivation. Meaningfulness of work and task is another factor, which contributes to employee's motivation to perform well. From their experiment, where participants (Mturk workers) had to find parasites in the blood sample with malaria, Toyoda et al. (2020) found that when workers were provided the meaning of the task and when AI was framed as a supportive tool (used supportive messages), their engagement (reported number vs true number of cells in the sample, metric developed and verified by researchers themselves) significantly increased (plus longer time on tasks and higher accuracy). At the same time, the results revealed that when the workers knew the task's rationale and what is expected from it, they tried to frame their actions to be more desirable – in Toyoda et al.'s experiment (2020) they have identified more false parasites in the blood sample with malaria, when they were

explained that the meaning of the task is to find them. Interestingly, workers were more engaged (not from the perspective of time and accuracy though) when AI was framed as a supervisor (used controlling language) and when the task was meaningless (Toyoda et al., 2020).

Chan and Humphreys (2018) explored the socio-technical context of algorithmic management. They studied how Uber drivers interpret algorithms and data, create communication networks and guide each other on forums, normalizing the production of the social space at work. The researchers discovered that certain tensions emerge between the company and the workers, because the discourse of Uber (claiming that their rating systems and navigation are "objective knowledge") contradicts with the real experience of the drivers (have to develop understanding on how the system works, in order to tackle its imperfections and avoid punishments) (Chan & Humphreys, 2018). Since drivers have to develop such interpretive practices to understand the data and algorithms, it leads to the creation of the social space between drivers and also sets the expectation for social interaction at their work (when they know how ratings are comprised and how they should interact with customers and also the platform). Authors suggest the term ***"digitally-enabled service workers"***, to demonstrate better how the data influences the emergence of expectations towards social interactions and how the power dynamics are mediated through various digital processes, leading to the peer-to-peer exchange of information and building algorithmic imaginary of the workers (Chan & Humphreys, 2018).

From the material already discussed in the previous chapters, there were several mentions of how the communication processes are organized and happen within these algorithmic systems and working conditions. For instance, Jarrahi and Sutherland (2019) discovered that workers under algorithmic management have developed a practice of sensemaking (understanding how the platform and algorithms work), which is not always a personal, but a shared activity – workers use ***online forums*** to exchange their knowledge of the platform and its policies, seek for some advice, help and support each other. While Möhlmann and Zalmanson (2017) discovered that Uber, as a labor providing organization, is not concerned about the issues of social connectivity between its workers. Almost all communication processes are mediated by the platform and because there is no human manager or co-workers, there is no direct support (only through chatbots or email) and no opportunity for social exchange. As a result of the lack of interactions and sociality, workers are unable to build either negative or positive social ties and might feel isolated, like if they were working for an abstract system, rather than an organization comprised of people. Besides, the researchers note that the communications are one-sided and not open, what makes it impossible to deliver any suggestions, complains or discuss management decisions. It is partly because Uber claims that it does not employ people but provides them an opportunity and means to work independently (Uber app) (Möhlmann & Zalmanson, 2017). On the contrary, in their study on Upwork, Jarrahi

et al. (2019) discovered that communications are not under the control of algorithmic management, even though happen through the platform.

Supporting several researchers in the field, Kaine and Josserand (2019) pointed out the importance of social media for gig work. It proved to be useful for community building, because this is not supported by the platform providers, and for the direct facilitation of gig work (in the context of knowledge-intensive work), because workers can do self-branding and display their skills and competence better. Moreover, workers used social media not only for exchanging their knowledge, but also for collective activism and for expressing their resistance towards the platform work conditions.

Another viewpoint on communications within algorithmic systems was provided by Shestakofsky and Kelkar (2020). In their research, the authors introduced and explored a new concept, which they called "relationship labor". It represents separate type of paid workers, who are responsible for persuading, engaging and assisting the platform users by means of interpersonal communications. It involves community managers (establish and maintain spaces for community building) and account/customer support managers (assist with tasks, resolve issues, communicate and handle user concerns, manage expectations and emotions) (Shestakofsky & Kelkar, 2020). Their findings, even though obtained from the research of slightly different type of platforms (where no direct labor is involved, e.g., EdEx), are still valuable for studying algorithmic management. First, the concept of relationship labor emerging in some of the existing algorithmic systems has not been noticed and pointed out in the existing literature on the topic, even though it is a practice that could be integrated by other platforms (Shestakofsky & Kelkar, 2020). This practice utilizes human workers to handle the situations, which require such skills as creativity, persuasion and situational response, which are specifically useful, when the algorithmic system lags or fails to meet stakeholders' expectations due to other technical issues. It is highly possible that relationship labor will gain popularity in the near future, due to the growth of deployment of algorithmic systems across the economy (Shestakofsky & Kelkar, 2020).

6 DISCUSSION

In this chapter, the findings of the review are discussed and the answers to the research questions provided.

6.1 Algorithmic Management and Leadership Defined

What are algorithmic leadership and algorithmic management? How they are defined? (RQ1)

By looking at the present literature on algorithmic management, it can be concluded that at the moment it is impossible to provide a concrete definition of the concept, as

it still needs to be revised. First of all, there is a misalignment of the present conceptualizations. For example, some researchers view algorithmic management as a practice, where the power and control are in the hands of the software (e.g., Lee et al., 2015; Möhlmann & Zalmanson, 2017; Mateescu & Nguyen, 2019), while others employ a perspective that the technology has just conveniently shifted this power from managers to other interested parties within the organization (e.g., Schildt, 2016; Wiener et al., 2019).

The absence of the exact definition of the term brings a lot of confusion into the field. Originally, "algorithmic management" was proposed and coined by Lee et al. (2015) in the context of Uber. However, other online labor platforms have not been acknowledged and distinguished from each other in this line of research, what has led to the term being used even in the context of Airbnb, where there is no labor happening (Cheng & Foley, 2019). Thus, there are still continuous innovations and developments of the term. For example, one recent deviation is "platformic management", introduced by Jarrahi et al. (2019), who address these contextual aspects and call up other researchers to consider the platform in focus, when talking about algorithmic management. Other examples include either complete innovations, based on a different conceptualization approach to the topic (e.g., Technology Mediated Control by Wiener et al., 2019) or total avoidances of mentioning it in the study (e.g., Sutherland & Jarrahi, 2018).

Nevertheless, by analyzing the present research evidence on both practices (discussed in chapter 5), it is possible to formulate tentative definitions and outline certain differences between algorithmic management and leadership practices. *Algorithmic management* can be perceived as a "big brother", who is, basically, forced on workers (they *have to* comply with its rules), is in charge of control and distribution of work, not interested in any feedback, and is utilizing very simple monetary non-personal incentives in a gamified manner to motivate subordinates to continue working. The nature of the practice is aimed to keep workers online, monitor their performance and behavior, assign the tasks and pay for them purely according to data. The only element that can be perceived as beneficial for the workers is the easiness of the on-boarding to the platform and the ability to work straight away. Important to mention that at the moment algorithmic management is present only in the app-work, according to the distinction based on Duggan et al.'s (2019) (figure 10, p. 61), at least based on the present academic evidence. There are a few mentions of algorithmic management integrations in regular organizations within the industry though (e.g, Fidler, 2015), but it needs to be researched in more detail.

The origin of *algorithmic leadership* seems to be more humanistic, as the practice is aimed at helping either a human user, a worker or a whole company (depending on the use case). In this context, it is more like a "companion", rather than a "big brother". In terms of present definitions of the phenomenon, as with algorithmic management, they are not agreed and often the same term is used to describe different applications. For example, some researchers perceive and refer to algorithmic leadership as to a

process, where a human user is completing a task and a computer agent, being a separate actor, interacts with the user and pursues a goal to motivate and guide him throughout the process (Derrick & Elson, 2019; Uhlin & Crevani, 2019). At the same time, others refer to algorithmic leadership when talking about corporate top-management – either its full automation or integration of artificially intelligent leader/business advisor to it (e.g., Parry et al., 2016; Harms & Han, 2019).

Thus, answering the first research question – what both concepts are - still remain to be researched more deeply, conceptualized and defined. Hopefully, the results of this review will prove to be useful for the topic's further advancements.

6.2 Traditional Theories & Contemporary Concepts

What elements of the traditional human management and leadership theories are present in their algorithmic substitutes? What is the same, what is different, what has been ignored and left behind?(RQ4)

There have been several indications that the field of study is only emerging and that it still lacks in research and conceptual groundings. To fill some of the present gaps, the present research evidence on algorithmic management and leadership will be reflected on the traditional theories of the corresponding practices (presented in chapter 2). This can also verify some of the areas in the algorithmic context, which are still under researched.

In Fayol's administrative theory**,** such operations as forecasting and planning, organizing, commanding, coordinating and controlling are outlined as central for the business to run and for its management. In algorithmic management we can see that all these functions are present, at least to a certain extent, and executed through the system and data algorithms. On Uber's example, the work demand is predicted and planned (e.g., holiday times rushes, Möhlmann & Zalmanson, 2017), workers are organized (matched with demand), commanded (to stay longer or to start working), coordinated (where to go) and controlled (tracked and evaluated). With this functions present, Uber's business is indeed operating and running. However, when it comes to how these processes are executed and weather the 14 management principles outlined by Fayol (chapter 2.1.1) are followed, the picture is rather different. The division of work and discipline are, indeed, present. Centralization is towards the system or "manager". Order and subordination are implied from workers, while authority has no responsibilities, and any of the employee-oriented functions (e.g., remuneration) are left out completely (e.g., Duggan et al., 2019). It can be concluded, that from Fayol's theoretical perspective on management, algorithmic substitute has gone through the transformation – the basic idea is still there, but the practice itself is new.

Taylor's scientific management theory has been the most popular benchmark with algorithmic management among researchers (e.g., Rosenblat & Stark, 2016; Pastuh & Geppert, 2020; Duggan et al., 2019; Schildt, 2016). From a glance, it might

seem that they are almost twins, as in both there is a job's science (specific principles and standards), according to which the work is distributed between workers and their performance evaluated. What have been forgotten, though, is that behind Taylor's thinking was the idea that a science should eradicate bias in performance evaluation, while in the algorithmic management the customers are free to evaluate the work based on their personal interpretation, which is contributed to the final grading of the work. Even more importantly, in scientific management, the science behind a particular job, or the standards of it, is, actually, known to workers, making them aware of what is expected from them and how the evaluation of their performance happens. In algorithmic management, this information is hidden from workers, forcing them to figure it out or to experiment (e.g., Bokányi & Hannák, 2020; Mateescu & Nguyen, 2019; Möhlmann & Zalmanson, 2017).

It seems that at the heart of the algorithmic manager lays the philosophy described in Theory X – workers are perceived as lazy, not able to contribute to organizational goals intellectually and are trying to avoid work and responsibilities, so require to be constantly controlled and supervised (Lawter et. al, 2015; Möhlmann & Zalmanson, 2017; Pastuh & Geppert, 2020). The opposite view on the issue - theory Y – could have potential to be at least tested by the algorithmic systems designers (platform providers), because, as many in the field suggest, the present work arrangement in this technology-mediated management cuts many essential practices (e.g., socialization with organization, co-workers, sense of autonomy), what, in turn, lowers the determination and desire of workers to contribute to organization and act from the perspective of virtue (Gal et al., 2020; Jabagi et al., 2019).

Herzberg's factor theory serves as a very insightful source of information to understand algorithmic management and how its present work arrangement affects workers. Even though some of the intrinsic motivation factors that lead to work satisfaction – achievement, recognition, work itself, responsibility, advancement, growth – are technically present in algorithmic management, though in a rather mutated form (e.g., achievement through gamification), most are absent and not available at all (Rosenblat & Stark, 2016; Schor et al., 2020). At the same time, the platform company's policy and administration, work supervision, relationship with supervisor, work conditions, salary, relationship with peers, status and security – have been reported in many studies as unsatisfactory and even improper (Duggan et al., 2019; Connelly et al., 2020; Kaine & Josserand, 2019). However, more detailed research is needed on what forms and affects workers' satisfaction in algorithmic management and platform work.

Looking at the present automation of management from the perspective of possible managerial roles (chapter 2.1.2), it can be noticed that the algorithmic manager is not granted any of the decisional roles within the working practice, as it does not invent or changes anything (entrepreneurial role), is not responsible for handling disturbances, resource allocation or negotiations. Mostly, it carries out informational roles: it analyzes information to evaluate the situation, taking the

monitoring role; informs workers about their present work statistics, acting as a disseminator; communicates results to the upper management (platform owners), acting as a spokesperson (e.g., Mateescu & Nguyen, 2019). From interpersonal roles, the situation is twofold. In algorithmic management, the system, in fact, acts as a liaison, establishing networks and relationships with other actors (workers, customers, external sources) to collect more data, but it does it in a different way than a human manager would do (relationships are of a purely transactional nature). At the same time, Jarrahi et al. (2019) proposed that in the "algorithmic management" and systems like Uber, liaison is not present, but it exists on other type of platforms, like Upwork, where "platformic management" prevails and the system entails more valuable connections and relationships between the actors. Figurehead role, responsible for handling formalities and legal issues, is also present to a certain extent, since everyone can become a worker just by agreeing with platform terms and sharing the identification document, but at the same time, workers are not technically employed, so the system (or algorithmic manager) refrains from any legal responsibilities (e.g., Kaine & Josserand, 2019). Lastly, a managerial role of a leader – to guide, support and motivate subordinates – falls outside algorithmic *management* practice, representing algorithmic *leadership* (e.g., Derrick & Elson, 2019).

As already mentioned before, the automation of leadership is not a straightforward concept, because it is sometimes related to the corporate leadership automation process (part of organizational governance) and to being one of the management functions (part of any management practice) (chapter 2.1.2). Thus, the research evidence on "algorithmic management" will also be partly incorporated in this analysis, in terms of why this practice lacks in leadership over subordinates. Harms and Han (2019) suggested that algorithmic leadership consists of the elements of e-leadership, distributed or shared leadership and substitutes for leadership.

From e-leaderhip perspective, Stokols et al. already in 2009 mentioned that use of technologies has led to constant contact between managers and employees, often resulting in higher stress, lack of socialization and belonging, as well as mutual understanding between subordinates. Algorithmic management itself can be perceived as "a constant contact", because workers constantly interact with the system (Möhlmann & Zalmanson, 2017). The present research evidence also confirms similar negative influences of the process on workers to be in place (e.g., Rosenblat & Stark, 2016). Thus, one of the possible conclusions can be that "algorithmic management" is a "dysfunction" of algorithmic leadership (which is, in this case, a "proper" and more humane way to automate management). Otherwise, algorithmic leadership seems to be an evolution (the next new form) of e-leadership (e.g., Uhlin & Crevani, 2019).

Shared or distributed leadership, is something completely absent in algorithmic management (no team activities, initiative recognition/permission, responsibilities are not shared and assigned). In the context when algorithmic leadership refers to being a part of corporate leadership, this element could possibly be present. For example, the present talks withing the industry come towards a

conclusion that AI will rather become a member of the corporate board, thus, becoming one of the organizational leaders and advisors, sharing the leadership with other board members (e.g., Rijmenam, 2018; Pugh, 2019). Nevertheless, integrating some of the components of team effectiveness (for instance, results-driven structure, collaborative climate, external support) could improve the experience of workers in algorithmic management.

Substitutes for leadership are also interesting to explore within the algorithmic context. From one point of view, the technology has substituted a human manager. However, if the algorithmic leader is a center of the focus and is perceived as a separate actor, then workers themselves actually substitute some of its functions (e.g, information and social exchange in online communities, emergence of community leaders) (Jarrahi & Sutherland, 2019). In such case, the strength of influence of the algorithmic systems over workers can be considered diminished, if it does not support or motivate them (Howell et. al, 1990). Sensemaking of system's algorithms logic, tricking the system in different ways and similar behavior of workers can be perceived as the one neutralizing algorithmic manager's influence. Trust of the subordinates towards the system can be a possible example of enhancers (reinforcements of influence) in algorithmic leadership/management, because, as studies of Lee (2018) or Bing et al. (2020) demonstrated, workers tend to follow and accredit the system's decisions more, if they trust its rationale.

From the Leader-Member Exchange theory perspective, in algorithmic management (like in Uber) the exchanges that happen between the system and subordinates are of a low quality (because even some work-related information is not openly shared, Kaine & Josserand, 2019) and most of the present systems are not designed with a purpose to have or reinforce these exchanges. Basically, it is impossible for the workers to ever become a part of the in-group. On practice, there is high workers turnover, low commitment, negative job attitudes or affective labor (e.g., Duggan et al., 2019; Lee et al., 2015; Munn, 2018), what could partly be connected to the absence of qualitative LMXs, but this issue still requires more research to make any certain conclusions.

As a conclusion, there are both differences and similarities between traditional management and its algorithmic replacement. Of course, this should not be a surprise – algorithmic management systems are the creation of humans, designed based on what is already known and proved to be working. Yet many questions still arise regarding why more humanistic elements have been mostly left out and disregarded. Maybe, they are just about to come, especially, as they are also considered to be more challenging to automate (Harms & Han, 2019; Rijmenam, 2018).

6.3 Role of Communications

What is the role of communications in these algorithmic practices? Are they perceived as a strategic asset?(RQ3)

A lot of research attention in literature was drawn towards how communications are organized within algorithmic management – peer-to-peer between workers, between them and the system, between them and the organization itself. Starting from the latter, it seems that some of the platform providing organizations underestimate the power and importance of social aspects of work, automating its management (e.g., Uber, food delivery), what leads to workers using social media for expressing frustration, resistance towards the company, exchanging knowledge and tips, and even for collective activism (Kaine & Josserand, 2019). Others, in fact, do acknowledge this and even invent new roles within the system, like "relationship labor" workers, who are responsible for ensuring the valuable social interactions and engagement of workers on the platform (Shestakofsky & Kelkar, 2020). This can be partly because the communication between workers and the system is totally absent – they are not asked for any feedback and are unable to negotiate anything with it (Möhlmann & Zalmanson, 2017; Pastuh & Geppert, 2020). As mentioned in the previous chapter (6.2), these algorithmic systems do not have any decisional roles, what makes them limited in a sense and what indicates that a human manager, who will be in charge of these managerial functions (e.g., communication, leading & supporting, as outlined in chapter 2.1.2), which technology is unable to substitute yet, still needs to be in place.

Even though the communication and social interactions are not enabled within algorithmic management, it is interesting that workers still initiate them on their own – create forums, communities and other social practices, in order to compensate for this lack of human interaction and managerial support (Chan & Humphreys, 2018; Jarrahi & Sutherland, 2019). Furthermore, many researchers in the field propose to integrate the use of social channels (e.g., social media) into the algorithmic practice, in order to improve knowledge sharing, collaboration, work engagement, organizational commitment (Jabagi et al., 2019).

An interesting notion is that similar pathways are suggested in the industry. It is recommended that for future improvements of algorithmic management, companies should integrate such practices, as asking for workers' feedback and allowing them to participate in the decision-making to a certain extent. This should enable two-way communication and, as a result, should produce more engagement, along with the improvement of the system itself (Rijmenam, 2020).

6.4 Present Problems and Possible Resolutions

What are the challenges and problematic parts of algorithmic management and leadership? At what levels they have been identified? What are the possible solutions or improvements to them? (RQ2)

One of the main problems presently reported in algorithmic management, is the absence of trust – both of the "algorithmic manager" towards workers, and vice versa.

For workers, it is not clear, how their performance is evaluated and the logic behind the system's decisions in general (Duggan et al., 2019). In order to follow the system and adopt its leadership, the high level of cognitive trust is required to be established (Glikson & Woolley, 2019). Some of the researchers assign the low transparency to the fact the platform providers keep more power and information to themselves, not willing to disclose it to workers (Rosenblat & Stark, 2016). However, the issue of opacity is common among all AI-powered decision-making systems in general – as they learn on their own with the time from data, their logic becomes less clear or "blackboxed" (Rijmenam, 2020). Thus, such things as bias and discrimination (Mateescu & Nguyen, 2019) are not always connected to the initial development of the system. At the moment, both researchers and practitioners work towards explainable AI systems – ones that are able to clarify how and why a certain decision are made (Barredo Arrieta et al., 2019). However, making the systems fully transparent is not considered to be a panacea either (e.g., De Laat, 2017), even though it can indeed positively affect the perception of system's decisions (Lee et al., 2018) and also enable drivers to make more informed decisions, overcoming present inequalities (Bokányi & Hannák, 2020).

From the system's perspective, workers are not trusted either and need to be constantly controlled and not given any freedom and autonomy over decisions (Mateescu & Nguyen, 2019). However, it is not very clear, how the workers could have more autonomy, if the decision-making based on data is considered to be a cause of diminishing it (Mengay, 2020). One of the solutions (that have been mentioned in the context of communication processes improvement as well) is to make the practice hybrid, integrating more human roles into it, making technology a human companion (Gal et al., 2020). This could be targeted to make the system smarter as well – if there will be humans, who would iterate its decisions, based on more information of the situation (Parry et al., 2016).

6.5 Limitations of the Review

This study aimed to be as broad as possible and to include many different perspectives on the topic, rather than exploring one specific issue like, for example, digitalization effects in HRM. However, as SLR is a highly time-consuming process, it had to have certain limitations. Thus, there were several research areas that were not part of the review. For instance, the study did not focus specifically on the literature on the gig-work, platform and sharing economy topics, even though it could potentially benefit from some of their findings as well. Besides, publications that focused only on the legal issues of labor in platform-based work and how they are solved, were also excluded from the review as well. Such granular stand-alone subjects as, for example, algorithmic hiring, were not included into the study, due to being less relevant for the main research objective and questions, which were targeted on more general practices of corporate management and their mediation by automation technologies.

A separate review on ethical issues and solutions in AI powered decision-making systems would be needed, as it is a different topic from the studied one in this research work. Technology resistance and adoption papers (out of relevant context) were not part of the study either, so only papers that focused on possible resistance in managerial/leadership implications of AI have been included, due to study resources limitations.

Moreover, it would be just impossible to explore and benchmark the present literature and research perspectives in the field with all existing prior theories of organizational management, leadership, motivation and communication within an adequate period of time. Even though, I believe, that further research on the topic could greatly benefit from exploring them, delivering more practical implications for these systems as well. Overall, this research area still remains on the verge of Information Technology (IT), Information Systems (IS), computer science and corporate management disciplines, what makes it challenging to research.

7 CONCLUSION

The present review has provided a state-of-the-art perspective on research on two emerging concepts - algorithmic management and algorithmic leadership – or, in other words, the automation of different management levels (middle and top). It can be concluded that it has been rather challenging to explain with certainty, what both of the concepts mean, purely based on the present research evidence, as there is a variety of perspectives and interpretations of both practices. This review depicts some of the present confusions, contributing to both formulation of the definitive explanation of the terms and to their further research direction.

Summarizing the discussion and answers to the research questions of this study, even though algorithmic management is, at present, an example of almost complete mediation of human management by technology, it still lacks in efficiency and has many drawbacks. Even though it might be working for such platform companies as Uber, it is still not something that most and more traditional organizations would implement, and on such a scale (full workforce management). One of the most visible and easy to implement way forward seems to be the integration of the automation technology into organizational processes (e.g., as has been done with iCEO, Fidler, 2015).

Taking this into account, organizations, deciding to use algorithmic management for their operations, might be left with questions. What role human managers will have in algorithmic management? Will these two sources of authority collide and conflict? How workers can counteract algorithmic decisions? What level of transparency will be granted to them? How big amounts of required data for AI learning can be collected without workers' privacy violations? How the ethical side of the issue can be approached and regulated? It is unclear what will be changing and how - people's perceptions and attitudes, the technology itself (as it might become

more advanced and to tackle some of the present issues), government policies and the strategic planning of the organizations (more human or productivity oriented). Yet, it is clear from the findings of this review that employing a humane, understanding perspective and a genuine intention to make the future of labor better, the outcomes can be plausible for all stakeholders involved.

REFERENCES

Altenried, M. (2020). The platform as factory: Crowdwork and the hidden labour behind artificial intelligence. Capital & Class, 00(0), 1-14.

Avolio, B. J., Kahai, S., & Dodge, G. E. (2000). E-leadership. The Leadership Quarterly, 11(4), 615–668.

Avolio, B. J., Sosik, J. J., Kahai, S. S., & Baker, B. (2014). E-leadership: Re-examining transformations in leadership source and transmission. The Leadership Quarterly, 25(1), 105–131.

Bartunek, Jean M., Philip Bobko, and N. Venkatraman. Towards Innovation and Diversity in Management Research Methods. The Academy of Management Journal 36.6 (1993): 1362-1373.

Bing, B., Hengchen, D., Dennis, J. Z., Zhang, F. & Haoyuan, H.. (2020). The Impacts of Algorithmic Work Assignment on Fairness Perceptions and Productivity: Evidence from Field Experiments. SSRN Electronic Journal.

Bokányi, E., & Hannák, A. (2020). Understanding Inequalities in Ride-Hailing Services Through Simulations. Scientific Reports, 10(1).

Carson, J. B., Tesluk, P. E., & Marrone, J. A. (2007). Shared Leadership in Teams: An Investigation of Antecedent Conditions and Performance. Academy of Management Journal, 50(5), 1217–1234.

Chan, N.K. & Humphreys, L. (2018). Mediatization of Social Space and the Case of Uber Drivers. Journal of Media and Communication, 6(2).

Cheng, M., & Foley, C. (2019). Algorithmic management: The case of Airbnb. International Journal of Hospitality Management, 83, 33–36.

Cochrane Collaboration. Retrieved 04.08.2020 from: https://www.cochranelibrary.com/about/about-cochrane-reviews

Connelly, C. E., Fieseler, C., Černe, M., Giessner, S. R., & Wong, S. I. (2020). Working in the digitized economy: HRM theory & practice. Human Resource Management Review.

Cooper, B. S., S. P. Stone, C. C. Kibbler, B. D. Cookson, J. A. Roberts, G. F. Medley, G.Duckworth, R. Lai, and S. Ebrahim (2004). Isolation Measures in the Hospital Management of Methicillin Resistant Staphylococcus Aureus (MRSA): Systematic Review of the Literature. BMJ 329: 1-8.

Davis, J., Mengersen, K., Bennett, S., & Mazerolle, L. (2014). Viewing systematic reviews and meta-analysis in social research through different lenses. SpringerPlus, 3(1), 511.

De Laat, P.B. (2017). Algorithmic Decision-Making Based on Machine Learning from Big Data: Can Transparency Restore Accountability? Philosophy & Technology, (31): 525–541.

Derrick, D. C., & Elson, J. S. (2018). Automated Leadership: Influence from Embodied Agents. Lecture Notes in Computer Science, 51–66.

Derrick, D.C. & Elson, J.S. (2019). Exploring Automated Leadership and Agent Interaction Modalities. 52nd Hawaii International Conference on System Sciences.

Drudy, C. (2018). Management Accounting for Business. 7th edition, Cengage EMEA.

Duggan, J., Sherman, U., Carbery, R., & McDonnell, A. (2019). Algorithmic management and app-work in the gig economy: A research agenda for employment relations and HRM. Human Resource Management Journal, 1-19.

Faraj, S. (2019). Algorithmic management: issues for organizational theory and design. Academy of Management Proceedings, 13-16.

Fidler, D. (2015). Here's How Managers Can Be Replaced by Software. Harvard Business Review on Labor.

Gal, U., Jensen, T. B., & Stein, M.-K. (2020). Breaking the vicious cycle of algorithmic management: A virtue ethics approach to people analytics. Information and Organization, 30(2).

Glikson, E. & Woolley, A.W. (2019). Theoretical Framework for Understanding Human Trust in Artificial Intelligence. Academy of Management Proceedings, 17-22.

Graen, G. B., & Uhl-Bien, M. (1995). Relationship-based approach to leadership: Development of leader-member exchange (LMX) theory of leadership over 25 years: Applying a multi-level multi-domain perspective. The Leadership Quarterly, 6(2), 219–247.

Grant, M.J., Booth, A. (2009). A typology of reviews: An analysis of 14 review types and associated methodologies. Health Information & Libraries Journal, 26, 91-108.

Greenhalgh, T. and R. Taylor (1997). 'Papers that go Beyond Numbers (Qualitative Research)', British Medical Journal. 315 (7110), 740-743.

Hackman, J. R., & Wageman, R. 2005. A theory of teamcoaching.Academy of Management Review,30: 269–287.

Harms, P. D., & Han, G. (2019). Algorithmic Leadership: The Future is Now. Journal of Leadership Studies.

Howell, J. P., Bowen, D. E., Dorfman, P. W., Kerr, S., & Podsakoff, P. M. (1990). Substitutes for leadership: Effective alternatives to ineffective leadership. Organizational Dynamics, 19(1), 21–38.

Hyatt, D. E., & Ruddy, T. M. (1997). An Examination Of The Relationship Between Work Group Characteristics And Performance: Once More Into The Breech. Personnel Psychology, 50(3), 553–585.

Jabagi, N., Croteau, A.-M., Audebrand, L. K., & Marsan, J. (2019). Gig-workers' motivation: thinking beyond carrots and sticks. Journal of Managerial Psychology.

Jabagi, N., Croteau, A., Audebrand, L.K. (2020). Perceived Organizational Support in the Face of Algorithmic Management: A Conceptual Model. 53rd Hawaii International Conference on System Sciences.

Jarrahi, M. H. (2019). In the age of the smart artificial intelligence: AI's dual capacities for automating and informating work. Business Information Review,

Jarrahi, M. H., & Sutherland, W. (2019). Algorithmic Management and Algorithmic Competencies: Understanding and Appropriating Algorithms in Gig Work. Lecture Notes in Computer Science, 578–589.

Jarrahi, M.H., Sutherland, W., Nelson, S.B., Sawyer, S. (2019). Platformic Management, Boundary Resources for Gig Work, and Worker Autonomy. Computer Supported Cooperative Work (CSCW). Springer Nature.

Kaine, S., & Josserand, E. (2019). The organisation and experience of work in the gig economy. Journal of Industrial Relations, 1-23.

Kitchenham, B. (2004). Procedures for Performing Systematic Reviews. Keele University Technical Report and Empirical Software Engineering National ICT Australia Ltd.

Koontz, H. (1980). The Management Theory Jungle Revisited. Academy of Management. The Academy of Management Review, 5(2): 175-187.

Kotter, J. P. (2001). What Leaders Really Do? Harvard Business Review. 23-34.

Lawter, L., Kopelman, R. E. and Prottas, D. J. (2015). McGregor's Theory X/Y and Job Performance: A Multilevel, Multi-source Analysis. Journal of Managerial Issues, Vol. 27, No. 1/4, 84-101.

Lee, M. K. (2018). Understanding perception of algorithmic decisions: Fairness, trust, and emotion in response to algorithmic management. Big Data & Society, 5(1).

Lee, M. K., Jain, A., Cha, H. J., Ojha, S., & Kusbit, D. (2019). Procedural Justice in Algorithmic Fairness. Proceedings of the ACM on Human-Computer Interaction, 3(CSCW), 1–26.

Lee, M. K., Kusbit, D., Metsky, E., & Dabbish, L. (2015). Working with Machines. Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems - CHI '15.

Leonardi, P.M., Huysman, M. and Steinfield, C. (2013), "Enterprise social media: definition, history, and prospects for the study of social technologies in organizations", Journal of Computer-Mediated Communication, Vol. 19 No. 1, 1-19.

Liberati, A., Altman, D.G., Tetzlaff, J., Mulrow, C., Gøtzsche, P.C., Ioannidis, J.P.A., Moher, D. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: Explanation and elaboration. Annals of Internal Medicine, 151, W-65.

Mateescu, A., & Nguyen, A. (2019). Algorithmic management in the workplace. Data & Society, 1–15.

McKendrick, J. (2020). It's Managers, Not Workers, Who Are Losing Jobs To AI And Robots, Study Shows. Forbes. Retrieved 1.01.2021 from:

https://www.forbes.com/sites/joemckendrick/2020/11/15/its-managers-not-workers-who-are-losing-jobs-to-ai-and-robots-study-shows/?sh=3cbbf29e20d5

Mengay, A. (2020). Digitalization of work and heteronomy. Capital & Class, 0(0).

Moher, D., Liberati, A., Tetzlaff, J., Altman, D.G. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. Annals of Internal Medicine, 151, 264-269.

Mulrow, C.D. (1994). Systematic reviews – rationale for systematic reviews. British Medical Journal, 309, 597–599.

Munn, L. (2018). Rendered Inoperable: Uber and the Collapse of Algorithmic Power. A Peer-Reviewed Journal About 7(1):14-25.

Möhlmann, M., Zalmanson, L. (2017). Hands on the wheel: Navigating algorithmic management and Uber drivers. 38th International Conference on Information Systems (ICIS 2017).

Noponen, Niilo (2019). Impact of Artificial Intelligence on Management. Electronic Journal of Business Ethics and Organization Studies, 24 (2), 43-50.

Nowotny, H., P. Scott and M. Gibbons (2001), Rethinking Science: Knowledge and the Public in an Age of Uncertainty. Blackwell Publishers, Maiden, MA.

Palmatier, R.W., Houston, M.B., Hulland, J. (2018). *Review articles: Purpose, process, and structure.* Journal of the Academy of Marketing Science, 46, 1-5.

Parry, K., Cohen, M., & Bhattacharya, S. (2016). Rise of the Machines. Group & Organization Management, 41(5), 571–594.

Pastuh, D. & Geppert, M. (2020). A "Circuits of Power"-based Perspective on Algorithmic Management and Labour in the Gig Economy, Industrielle Beziehungen. Zeitschrift für Arbeit, Organisation und Management, 179-204.

Pittaway, L., (2011). Dictionary of Qualitative Management Research. Systematic Literature Reviews. SAGE Publications, 217-218. Access Date: August 5, 2020.

Popay, J., A. Rogers and G. Williams (1998). 'Rationale and Standards for the Systematic Review of Qualitative Litera- ture in Health Services Research', Qualitative Health Research, 8 (3), 341-351.

Pugh, W. (2019). Why Not Appoint an Algorithm to Your Corporate Board? Slate. Retrieved 9.01.2021 from https://slate.com/technology/2019/03/artificial-intelligence-corporate-board-algorithm.html

Rijmenam, M. V. (2020). Algorithmic Management: What is It (And What's Next)? Artificial Intelligence Blog. Retrieved 24.12.20 from: https://vanrijmenam.nl/algorithmic-management-what-is-it-whats-next/

Rosenblat, A., & Stark, L. (2016). Algorithmic Labor and Information Asymmetries: A Case Study of Uber's Drivers. International Journal of Communication, 10.

Schawbel, D. (2019). How artificial intelligence is redefining the role of manager. World Economic Forum. Retrieved 5.01.2021 from: https://www.weforum.org/agenda/2019/11/how-artificial-intelligence-is-redefining-the-role-of-manager/

Schildt, H. (2016). Big data and organizational design – the brave new world of algorithmic management and computer augmented transparency. Innovation, 19(1), 23–30.

Schor, J. B., Attwood-Charles, W., Cansoy, M., Ladegaard, I., & Wengronowitz, R. (2020). Dependence and precarity in the platform economy. Theory and Society.

Shestakofsky, B., & Kelkar, S. (2020). Making platforms work: relationship labor and the management of publics. Theory and Society.

Siddaway, A. P., Wood, A. M., & Hedges, L. V. (2018). How to Do a Systematic Review: A Best Practice Guide for Conducting and Reporting Narrative Reviews, Meta-Analyses, and Meta-Syntheses. Annual Review of Psychology, 70(1).

Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. Journal of Business Research, 104, 333–339.

Stokols, D., Mishra, S., Gould-Runnerstrom, M., Hipp, J., (2009). Psychology in an age of ecological crisis: From personal angst to collective action. American Psychologist, 64 (3), 181-193.

Sutherland, W., & Jarrahi, M. H. (2018). The sharing economy and digital platforms: A review and research agenda. International Journal of Information Management, 43, 328–341.

Thomson, K., (2003). The Principles of Scientific Management by Frederick Winslow Taylor. The Early Sociology Of Management and Organizations, vol (1). Routledge Taylor & Francis, London and New York.

Toyoda, Y., Lucas, G. & Gratch, J. (2020). The Effects of Autonomy and Task meaning in Algorithmic Management of Crowdwork. In Proceeding of the 19th International Conference on Autonomous Agents and Multiagent Systems (AAMAS 2020).

Tranfield, D., Denyer, D. & Smart, P. (2003). Towards a Methodology for Developing Evidence-Informed Management Knowledge by Means of Systematic Review. British Journal of Management, 14: 207-222.

Uddin, N., Hossain, F. (2015). Evolution of modern management through Taylorism: An adjustment of Scientific Management comprising behavioral science. Procedia Computer Science, 62, 578 – 584.

Uhlin, A. & L. Crevani (2019). Is e-leadership development enlightening? Handling fragmentation by making leadership algorithmic. 35th EGOS Colloquium.

Vallas, S., & Schor, J. B. (2020). What Do Platforms Do? Understanding the Gig Economy. Annual Review of Sociology, 46(1).

Van Wart, M., Roman, A., Wang, X., & Liu, C. (2017). Operationalizing the definition of e-leadership: identifying the elements of e-leadership. International Review of Administrative Sciences.

Webster, J., Watson, R. (2002). Analyzing the past to prepare for the future: writing a literature review. MIS Quarterly. Vol. 26 No. 2, 13-23.

Weisberg, M., & Dent, E. (2016). Meaning or money? Non-profit employee satisfaction. Voluntary Sector Review, 7(3), 293–313.

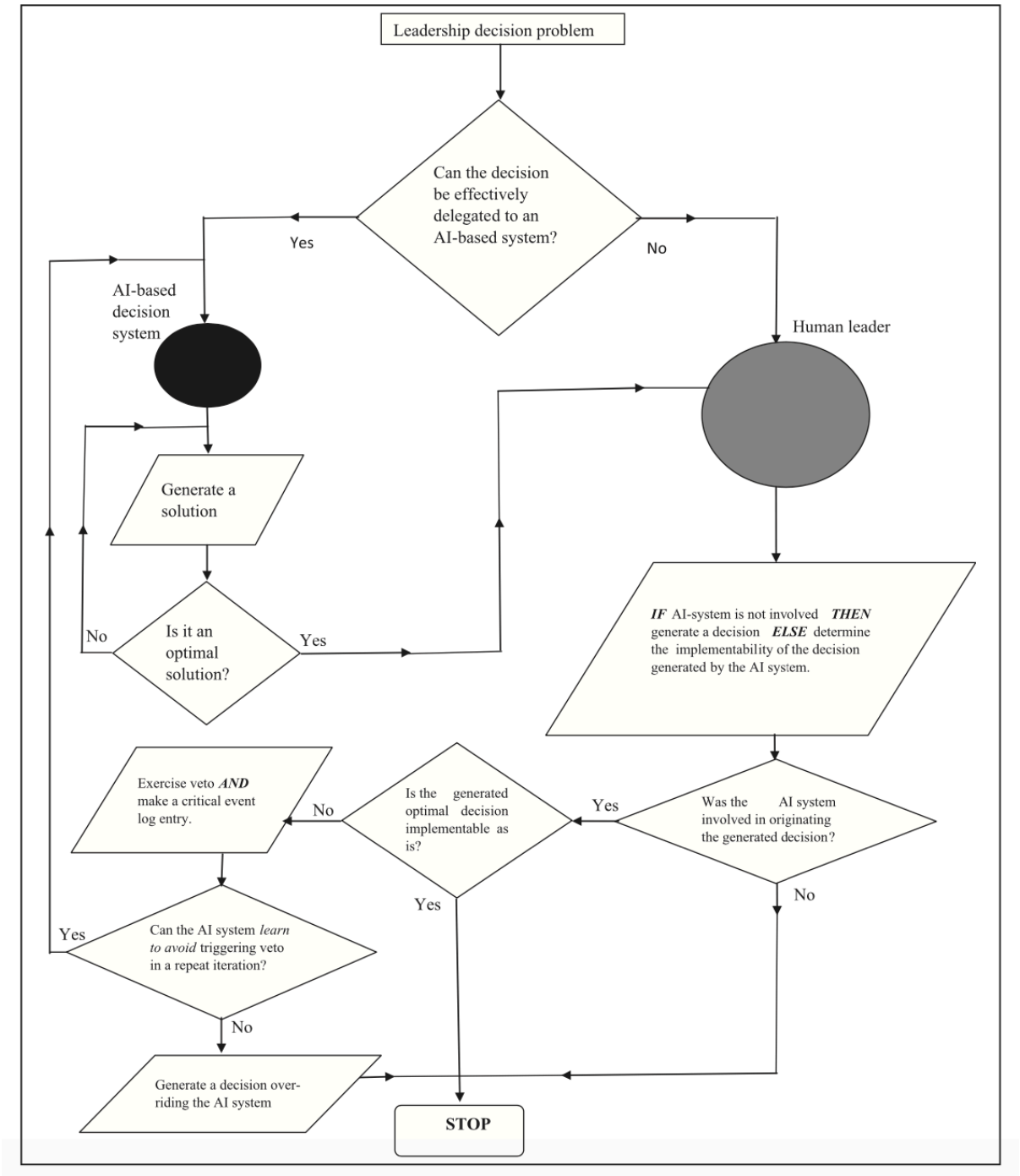
Wesche, J. S., & Sonderegger, A. (2019). When computers take the lead: The automation of leadership. Computers in Human Behavior.

Wiener, M., Cram, W., Benlian, A. (2019). Technology-Mediated Control Legitimacy in the Gig Economy: Conceptualization and Nomological Network.

Yu, H., Miao, C., Chen, Y., Fauvel, S., Li, X., & Lesser, V. R. (2017). Algorithmic Management for Improving Collective Productivity in Crowdsourcing. Scientific Reports, 7(1).

APPENDICIES

Appendix 1. The flow chart of algorithmic leadership decision-making process with human veto in it (Parry et al., 2016).



Appendix 2. A circuits of power framework applied to algorithmic management (Pastuh & Geppert, 2020).