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## Algorithmic management on digital labour platforms: A systematic literature review

*Gerenciamento algorítmico nas plataformas digitais de trabalho: Uma revisão sistemática de literatura*

*Gestión algorítmica en plataformas digitales de trabajo: Una revisión sistemática de la literatura*

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### ABSTRACT

This study aims to understand algorithmic management in digital work platforms. To this end, a systematic literature review was conducted in the main databases of the Administration field. Initially, 912 studies were surveyed that went through inclusion and exclusion criteria, resulting in a corpus of 39 articles. The results produced demonstrated the existing research perspectives, definitions and conceptualizations, their similarities and discrepancies, assisting the development of future research and leading researchers in the area. The contribution of this study consists in making the conceptualization process of algorithmic management more understandable and systematic, guiding towards a uniform direction instead of scattered perspectives.

**Keywords:** management; algorithmic management; digital work platforms; working conditions; systematic literature review.

### RESUMO

Este estudo tem como objetivo compreender o gerenciamento algorítmico nas plataformas digitais de trabalho. Para isso, foi realizada uma revisão sistemática de literatura nas principais bases de dados do campo da Administração. Inicialmente foram levantados 912 estudos que passaram por critérios de inclusão e exclusão, resultando em um corpus de 39 artigos. Os resultados produzidos demonstraram as perspectivas de pesquisa existentes, definições e conceituações, suas semelhanças e discrepâncias, auxiliando o desenvolvimento de pesquisas futuras e principais pesquisadores da área. A contribuição deste estudo consiste em tornar o processo de conceituação do gerenciamento algorítmico mais compreensível e sistemático, orientando para uma direção uniforme em vez de perspectivas dispersas.

**Palavras-chave:** gestão; gerenciamento algorítmico; plataformas digitais de trabalho; condições de trabalho; revisão sistemática da literatura.

### RESUMEN

Este estudio tiene como objetivo comprender la gestión algorítmica en las plataformas digitales de trabajo. Para ello, se realizó una revisión sistemática de la literatura en las principales bases de datos del ámbito de la Administración. Inicialmente, se relevaron 912 estudios que pasaron por criterios de inclusión y exclusión, resultando en un corpus de 39 artículos. Los resultados producidos demostraron las perspectivas de investigación, definiciones y conceptualizaciones existentes, sus semejanzas y discrepancias, auxiliando el desarrollo de futuras investigaciones y orientando investigadores en el área. La contribución de este estudio consiste en hacer más comprensible y sistemático el proceso de conceptualización de la gestión algorítmica, orientando hacia una dirección uniforme en lugar de hacia perspectivas dispersas.

**Palabras clave:** gestión; gestión algorítmica; plataformas digitales de trabajo; condiciones de trabajo; revisión sistemática de la literatura.

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## 1 INTRODUCTION

Changes in the world of work from the manual jobs in the 18th century (Cherlin, 2019; Edin et al., 2019) to the use of water and steam powered machines aim at continuously increasing human productivity. Currently, information and communication technology (TIC) through electronic devices transform labour by using totally automated devices, which has led to the replacement of workers. This decade is fuelled by a combination of forces like technological dysregulation, globalisation and widespread use of algorithms, which are ever more present in social daily life. According to Ferrari and Graham (2021), algorithms take center stage in society, playing a key role in shaping the way people live, love and work. These algorithms play a guiding and redirecting function in mechanical processes, directly impacting the assignment of school grades and admission to higher education institutions, as well as influencing the transmission and management of jobs. For the authors (2021), algorithms exert a mediating power, enabling and constraining social actions across a wide range of domains.

In recent years, the literature on the topic has highlighted that algorithms can herald a new era of transparency, efficiency and good governance (Rogers, 2018). In opposition to this, there is an academic literature that reveals a deep area of research that casts criticism on the certain social benefits of algorithms. Studies in this vein have highlighted how algorithmic search features reinforce racial biases, as pointed out by Noble (2018). In addition, automated decision-making has been the subject of research that highlights its negative effects on working-class communities, as discussed by Eubanks (2018). Rani and Furrer (2021) explore the relationship between quantification and precarious work, demonstrating how algorithms are involved in this process. While these critical approaches run counter to the optimistic view on algorithms, both have encouraged a belief in the potential to transform these technologies in society. Thus, a notion of algorithmic hegemony emerges as a central element in contemporary analyses of power relations in today's Society. Algorithms took over organisations, their decision-making spaces, control, surveillance, planning and activities scheduled through internal and external data collection. They are here to mediate middle management, through execution of control, supervision, workforce organisation, task assignment, feedback and even motivation of employees (Mateescu & Nguyen, 2019; Derrick and Elson, 2019).

The power and control relationship that algorithms exert on the workforce is called algorithmic management. According to Kaine and Josserand (2019), the phenomenon of algorithmic management is a hot topic of both practitioners' and researchers' debate at this moment, which highlights the need for further work on the issue. Nonetheless, this scientific field is still developing and its boundaries are not quite definite. Sutherland and Jarrahi (2018) emphasise in their study the lack of agreement on a name for the phenomenon (for example, algorithmic

management), since different researchers have different definitions for "algorithm" and some papers describe the technology as a platform, even though they focus only on one algorithmic process of that platform. Jabagi et al. (2019) also characterise one of the research fields conceived as part of algorithmic management, which is called sharing economy. Despite increasing academic interest, the literature is still scarce on how algorithmic management is employed in digital work platforms. This article aims to provide that information by systematically reviewing the literature in a qualitative analysis of 39 articles on the issue. Therefore, to better understand this phenomenon that seems to have the potential to disrupt organizational fundamentals, a systematic literature review was deemed necessary. Employing a systematic literature review as research methods is advantageous to map and to assess the intellectual territory of a certain subject (Tranfield, et al. 2003, p. 208), to facilitate the development of theory and to create a basis to further develop knowledge (Webster & Watson 2002). It also facilitates the formulation and the establishment of a research area by limiting it to a reasonable scope and clarifying uncertainties and misconceptions. In addition, a systematic literature review also shows the influences of this new management model on working conditions, specifically, for workers on digital platforms.

The automation of management has evolved and managers have been replaced with technology. These recent changes prove that intelligent technologies can execute basic management functions efficiently and many companies now rely almost exclusively on technology systems (Uber, Ifood, Amazon, etc.). This issue has called forth national and international researchers, some of who conceptualize the practice of automation in companies as algorithmic management, whereas others still consider it a form of algorithmic leadership that may happen in some companies (Harms & Han, 2019; Parry, Cohen & Bhattacharya, 2016; Wesche & Sonderegger, 2019). Since, these are new and emergent concepts, it is not very clear what they mean exactly.

Kaine and Josserand (2019) defined algorithmic management as a hot topic between practitioners and researchers. Despite the increase in the academic interest, the field has faced a few challenges (ambiguous terminology and definitions). A likely explanation for such a fact lies in the interdisciplinary nature of the issue, consequently, there is an array of research perspectives in particular fields (Jabagi, et al., 2019). Hence, it is strategic to provide a literature review on the subject that is capable of outlining the state of the art and facilitate the constitution and establishment of that research area, constraining it to a reasonable scope and clarifying uncertainty and mistakes. This management model has worked for over a decade, however, in companies like Uber, for example, people lack the understanding on how such systems are designed and how one works under such management. Furthermore, over the years, the number of online labour platforms has

increased not only for operational jobs but more specialised functions, which slowly turn into platforms such as Upwork.

Although most articles on the subject were published in the same interval (2019 and 2021), their perspectives, terminology and concepts vary. Hence, the present SLR aimed to understand algorithmic management of digital labour platforms. This article aims involve the collection and the analysis of scientific articles focused on an automated model managed by algorithms from the point of view of researchers in academia and in companies. With that purpose, a systematic literature review was developed guided by the following research question (RQ): how does the algorithmic management on digital labour platforms take place?

This investigation collects and reviews the knowledge available on management processes and control mediated by algorithms. The findings will show the current research perspectives, introduce definitions and concepts, their similarities and differences, which can contribute to develop for future research and create an overview of researchers in the area. Hence, the study can contribute, to a certain degree, to make the conceptualization of the subject easier and more systematic, indicating a uniform direction rather than diffuse perspectives. Furthermore, the results must bring clarity to existing ambiguities and misconceptions; they will also outline the scope of the subject, which are essential conditions as claimed by Palmatier et al. (2018) and Snyder (2019).

## 2 THEORETICAL FRAMEWORK

Better understanding of algorithmic management is necessary to contextualize the phenomenon. On digital platforms, algorithmic management is related to sharing economy, also called platform economy. Sharing economy is generally defined as the exchange of capital, assets and services between individuals using Internet-based platforms to share underutilized resources at low cost of transaction (Jabagi et al., 2019).

The paradigm of sharing economy promises an increase in economic efficiency, environmental benefits and economic growth, through the use of apps in the areas of mobility (transport, rides), food delivery, orders, housework, etc. Despite the widespread use of TICs in several activities, their use has changed work relationships, bringing new challenges that have been intensely debated over the last few years. Schor and Attwood-Charles (2017) argue that low quality work conditions are pivotal in this new modality of work, mostly because they are not regulated yet. On the other hand, Graham and Woodcock (2018) claim that workers lack the power to bargain with the platform, being subjected to rules they cannot question.

The term sharing economy rose with the financial crisis in 2007-2008, when a growing number of workers began to execute small tasks, in a series of casual short-term jobs to earn a living (Sukhodolov & Beryozkin, 2018).

The concept has evolved since then to embrace a series of online digital platforms connecting workers with both online and off-line tasks in digital markets (Acs, et al., 2021). Despite the academic, political and legal debates, sharing economy platforms appeared after Uber was created. Nonetheless, these platforms still lack regulation to work digitally and to protect and to provide guarantees to workers. This includes short-term renting such as Airbnb, food delivery like iFood and Rappi, outsourcing platforms, such as Amazon's Mechanical Turk and many others. Hence, many people are attracted by the flexibility and the autonomy that sharing economy platforms provide, leading to an intense increase in the number of participating workers (Hall & Krueger, 2018) as well as the presence of this work model in many other sectors.

In the world, it is likely that at least 90 million people have registered on digital platforms to perform some sort of work (International Labour Organization [ILO], 2021). In addition, platforms are expanding in number and types of activities, so that until 2025, over 30% of the global value will be generated by platform companies. This means an annual growth of 27% (McKinsey Global Institute, 2017). In the last few years, we have seen a remarkable growth in the diversity of research that investigates the experiences of workers on digital labour platforms, listing the criteria for a desirable platform labour. (Flanagan, 2019; Graham, et al., 2020; Kinder, et al. 2019; Myhill, et al., 2021; Rani & Furrer, 2021; Vieira, 2020; Wu & Li, 2019), exploring the worker's property and forum and platforms governance (Heeks et al., 2021; Polkowska, 2019; Rani & Furrer, 2021; Sun, 2019; Wood, et al. 2019). Nonetheless, the challenges identified by Silberman et al. (2010), Bederson and Quinn (2011) and others (Kittur, et al., 2013) in great part remain, indeed, new platforms can be identified nowadays besides Mechanical Turk, much investigated by the authors, and more recently Uber.

Digital labour platforms are easily recognised as a new way to organise labour that is mostly or exclusively digital. Workers must agree to be legally classified as independent workers instead of employees, even if the characteristics of the work indicate the contrary. Nonetheless, the key element for digital labour platforms, like Irani and Silberman (2016) identified, is the principle of automated or algorithmic management or simply algorithmic management.

The studies by Harms and Han (2019) provide fundamental definitions to understand algorithmic management as they conceptualise how systems aim to organise and to control employees, mostly by offering financial rewards and threats of dismissal. The authors also approach the need to improve corporation communication, leadership and motivation of workers. There are many articles that mention algorithmic management, however, this article focuses on and discusses the publications that are more central to the issue, that is, those that define the phenomenon of algorithmic management and discuss it in

the attempt to conceptualise it. Some articles are likely to contribute by employing a different concept, which leads to a totally formed perspective on the on-going dialogues in this research field (Altenried, 2020; Aneesh, 2009; Duggan, et al. 2019; Faraj, et al., 2018; Fleming, 2017; Möhlmann & Schildt, 2017; Zalmanson, 2017; Zuboff, 2019).

### 3 METHODOLOGY

#### 3.1 Systematic Literature Review

The systematic literature review (SLR) can be defined as an organised manner of collecting material available on a certain research issue to synthesise it (Snyder, 2019). A properly conducted SLR can provide a solid foundation to promote knowledge in a certain field and facilitate its development (Palmatier, et al., 2018). The origin of SLR lies in the field of investigation, unlike business management and information systems. Therefore, SLR in the field of Administration has proved advantageous and most productive in recent years (Snyder, 2019).

SLR can also be defined as an 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 systematic review can generate observation, evaluation, extension or development of theory, through linking the available evidence to theory and theory to evidence (Siddaway, et al., 2018). We designed a general protocol to systematize the SLR. The protocol considered the research question to collect data as detailed in the next section.

#### 3.2 General Protocol

To ensure a broad research question yet efficient in the search for results that help to understand the issue, we employed the method PICOC (Petticrew & Roberts, 2006). This method adds researchers to elaborate a practical research question by indicating the elements: population, intervention, comparison, results and context. When we apply PICOC, it is possible to focus on the most relevant aspects for the study in question. In the present work, the elements identified in PICOC are:

- Population: works that depict algorithmic management as management, governance and work control mediated by digital platforms;
- Intervention: use of algorithmic management strategies to control workers on digital platforms;
- Comparison: not applicable since algorithmic management will not be compared. The present study only collects as much information as possible to build a catalogue that contains a detailed analysis of publications that approach algorithmic management on digital labour platforms and how that has interfered with one's working conditions.
- Results: the ways in which algorithmic management and their strategies for controlling the behaviour of

workers have influenced working conditions on digital platforms;

- Context: works that approach algorithmic management as a management model for labour on digital platforms.

We identified the investigations that use the concept of algorithmic management and for a better synthesis of the information, we performed a qualitative analysis with the following data: (1) number of publications per year, (2) number of citations per article, (3) publishing venues, (4) identified characteristics and (5) main contributions. We conducted a complementary qualitative analysis and described important aspects of the conceptual application. We also conducted manual research that included referents and journals related to algorithmic management. Google Scholar was used to support the searches with additional information about each article, such as number of citations and author's information.

Given the motivation and the research question, we elaborated a research protocol with the basics for data collection, the string used to search for publications, the inclusion and exclusion criteria and the quality assessment criteria. We selected the following digital libraries as sources: Web of Science, ACM Digital library, IEEE Explore, Science Direct (Elsevier), Scopus e Springer Link. These indexation bases were selected due to their relevance and because they collect journals, conference proceedings, workshops without limitation of date and field. In addition, they also presented more results after the research string.

In the collection, the first step to define the searches was to select keywords. The list of keywords was based on the structure and the aims of a SLR, to prevent the omission of significant terms. We used the following research string: ("labour conditions" OR "precarisation of platforms" OR "decent work") AND ("gig economy" OR "platform economy" OR "sharing economy" OR "algorithmic management" OR "algorithmic governance" OR "digital labour"). We used a search string on the digital libraries to conduct an automatic search and to collect data on 11 October 2021. We found a total of 912 studies as seen on Table 1.

**Table 1**  
Results of the automatic search on digital libraries

Digital Library	Results	Percentage
ACM Digital library	87	10%
IEEE Explore	33	4%
Science Direct (Elsevier)	110	12%
Scopus	326	36%
Springer Link	312	34%
Web of Science	44 <sup>a</sup>	4%
Total	912	100%

Source: Elaborated by the authors.

Note: The search on the data bank Web of Science found 38 publications, however, after applying snowball technique (Bockorni & Gomes, 2021) we added 6 publications available on this platform.

Table 1 details the number of publications and their representativity according to the data collected. Despite the amount of data in Table 1, not all publications were selected for the present study. We outlined a set of criteria to refine

the search, since despite meeting the criteria for an initial search, some articles would not contribute significantly to the aim of the study. The inclusion and exclusion criteria were established to enable the selection of publications capable of answering the research question.

These were the inclusion criteria for the current SLR:

**(I1)** Peer-reviewed articles, conferences and workshops that discuss algorithmic management in digital labour platforms or;

**(I2)** Relevant studies cited by the authors of articles read during the process using snowball technique. This technique consists in searching the references cited in the articles to identify other studies that would potentially be of interest to our investigation (Bockorni & Gomes, 2021). Therefore, it may contribute to finding and including more relevant data in the SLR.

The pre-defined exclusion criteria were:

**(E1)** Studies not available to download, even after contacting the authors via e-mail;

**(E2)** Studies with the abstract available only; extended abstract or short articles;

**(E3)** Studies with the same content or duplicates;

**(E4)** Studies published in languages other than English;

**(E5)** Studies that fail to answer the research question;

**(E6)** Studies that fail to meet the quality criteria.

Since not all criteria are mutually exclusive and the order of execution is important, we followed the criteria according to the following order of priority: I1, I2, E1, E2, E3, E4, E5 and E6. This is the final step in the selection of articles that will become objects of analysis, since we will only select the publications that meet inclusion criteria I1 or I2 and lack exclusion criteria.

We applied the inclusion and exclusion criteria, except for E6, to the results of the first collection (Table 1)

by evaluating titles, keywords and abstracts. However, in some cases, it was hard to determine whether the research was relevant based on the reading of that information alone. Therefore, when there were doubts as to the inclusion of a certain study, we recommended (for this particular step) the inclusion of the article and postpone the decision to the final selection.

In the selection process, 714 of the 912 studies were refused after the exclusion criteria were applied. However, based on this first selection, only 198 primary studies were subjected to the quality assessment criteria in order to form the final sample for the review. Despite the lack of an agreement of what is to be conceived as a high-quality study, there is, however, it is agreed that the quality of primary studies is pivotal for more reliable results (Kitchenham & Charters, 2007). Quality assessment criteria were defined to measure the quality of each primary study, necessary to produce reliable outcomes in the SLR. We outlined four quality assessment criteria (QA1-QA4) defined to be considered in the application of exclusion criteria E6, using a similar approach to Souza et al. (2019) based on bibliometric information of impact.

While QA1 uses four general criteria and four specific criteria, QA2 uses the classification of forums of publications, QA3 uses citations of the articles and QA4 relaxes QA3. Each one of these criteria is discussed in the sequence. The criteria QA1 is calculated using the Quality Index, where the general (G) and the specific (S) are factors of evaluations we resumed in Table 2. The result is a numeric representation to classify the studies we selected. The list of quality evaluation, with G and S composed of four items each and each with maximum score of 1, presents a weighted mean where S weights 3 times more than G, since the specific contributions (S) of a study are more relevant than the general (G) ones.

**Table 2**

Quality Criteria

General criteria	Specific criteria
<p><b>G1:</b> Definition of the problem and motivation of the study:                      (1,0) there is a clear description of the problem and the motivation.                      (0,5) there is a general description of problem and motivation.                      (0,0) there is not any description of either problem or motivation.</p> <p><b>G2:</b> There is a methodological description of the study:                      (1,0) there is a detailed description of the method.                      (0,5) there is only a simplified description of the method.                      (0,0) there is not any description of the method.</p> <p><b>G3:</b> the contributions of the publication refer to the outcomes of the state:                      (1,0) there is an explicit correlation between the contributions and the results.                      (0,5) there is no correlation between the contributions and the results.                      (0,0) there is no correlation between the contributions and/or the results.</p> <p><b>G4:</b> There is the description of the study validation:                      (1,0) there is a formal description of the study validation.                      (0,5) there are only some information provided about the study validation.                      (0,0) there is not any type of validation for the study.</p>	<p><b>S1:</b> Does it approach the concept of algorithmic management?                      (1,0) there is a clear description of the concept.                      (0,5) there is another word to describe the concept.                      (0,0) there is no description of the concept.</p> <p><b>S2:</b> There are characteristics of algorithmic management?                      (1,0) there is a detailed description of the characteristics.                      (0,5) there is a simplified description.                      (0,0) there is not any description.</p>

Source: Elaborated by the authors.

Given the aspects and the criteria established in Table 2, QA1 can be calculated (QualityScore) using the following equation:

$$QualityScore = \left[ \frac{\sum_{G=1}^4}{4} + \left( \frac{\sum_{S=1}^4}{2} \times 3 \right) \right]$$

Studies that score > 3 can be considered of QA1 = 'high', studies that score ≥ 1,5 and ≤ 3 can be considered of QA1 = 'average' and studies that score < 1,5 can be considered of QA1 = 'low'. It is noteworthy that we did not assess the quality of the studies, only the alignment

between the contributions of the study and the expectations of the research question. QA2 can be used to assess the forums where the studies were published. Therefore, studies published in forums classified as A or QA1 and QA2, can be considered QA2 = 'high'; studies published in forum classified as B or QA3 or QA4 can be considered QA2 = 'average'; studies published in forums classified as C or not classified can be considered QA2 = 'low'. It is important to highlight that such classification can be found, for example, at CORE-ERA for conferences and SJR for journals. QA3 can be used to assess studies according to their citations, considering 'high' the studies with more than five citations; 'average' the studies with up to five citations; 'low' the studies with no citations. In this case, QA4 can be used to relax QA3, considering, for example, the studies published in the last five years (for more updated knowledge) 'high' are studies with more than two citations (or even one); 'average' are the studies with one or no citations. To prevent exclusion by the criteria E6 (quality), a study ought to obtain, for example QA1  $\geq 1,5$  and (QA2 and QA3) or (QA2 and QA4) equal to 'average' or 'high'. The scores, limits and classifications were determined according to Souza et al. (2019), who employed the same criteria (QA1-QA4) employed in the present study.

After the quality assessment, we applied all of the inclusion and exclusion criteria (including E6) on the studies from the first step of the research by evaluating them in totality. Therefore, 70 of the 198 studies were rejected according to the exclusion criteria (E1-E5). After applying criterion E, 89 articles obtained QA1 inferior to 1,5 or proved inferior in one or more criteria (QA2, QA3, or QA4) reducing to 39 the sample for the systematic literature review. Following the analysis of the 39 studies, we classified them in accordance to the quality criteria as follows: 5 articles were published in conferences classified as level A in the CORE-ERA and 34 articles were published in journals: 22-Q1; 10-Q2 and 2-Q3, according to the SJR classification for journals.

The selection of 39 articles allowed for the beginning of the data extraction stage in order to extract data from the primary studies and consolidate results. Hence, the set of 39 primary studies was analysed and each study was given a unique identification in the data extraction form. The data was extracted from the studies in a specific form to record relevant information pertaining to the research question. To that end, we created a model with five sections that were filled in according to the following information:

**Section 1** (mandatory): recording basic information about the article – identification, title, conference or journal, year, number of citations, digital library.

**Section 2** (mandatory and related to RQ) recording the aim of the study in its approach to algorithmic management.

To mitigate the risk concerning the quality of the studies selected for analysis, we selected only peer-reviewed articles and used QualityScore to reduce analysis subjectivity. We also applied evaluation criteria defined

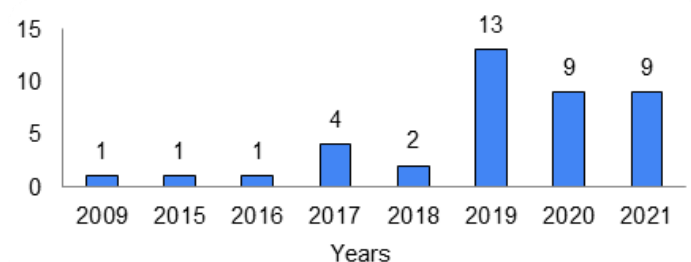
based on bibliometric impact (widely employed in systematic reviews). Regarding the validity of data collection, given the unknown dynamic of search mechanisms of digital libraries, different results are likely to be generated at each turn. Hence, the search was conducted through a search string and, to eliminate the chances of alterations in the list of articles provided by the digital libraries, the resulting studies were stored for analysis and data extraction by a bibliographic management tool, the software StArt. To mitigate issues in data extraction, the articles were classified to receive only the data necessary to answer the research question, as recommended by Kitchenham and Charters (2007). Therefore, it was possible to identify exactly what would be extracted from the articles and how to store and organise the data.

## 4 ANALYSIS AND DISCUSSION OF RESULTS

### 4.1 Demographic Data

Once we consolidated the data and reviewed the results, we constructed a summary of demographic data of the primary studies and situated the results according to the research question. Among the 39 primary articles, 5 were published in conferences, between 2016 and 2021, with most publications on *Conference on Human Factors in Computing Systems*, which is considered the most prestigious conference about the relationship between men and machines, also among the best for computation science. The 35 studies were published in journals with classification ranging from Q1 and Q3 according to SJR in the interval between 2009 and 2021.

The timeline and the distribution of publications about algorithmic management is shown in Figure 1. The first theoretical contributions were made in 2009 by Aneesh (2009) through the term algocracy, but it was in 2015 that the term algorithmic management was introduced, created and disseminated by Lee et al. (2015). Almost all of the research sample was published between 2019 and 2021 (32 out of 39 articles), indicating that the field is still emerging. It is also possible to observe the quick rise in the interest in the subject over the last three years. This might be due to the growth and the visibility that digital labour platforms have conquered during this time.



**Figure 1.** Distribution of the years when the studies were published.

Source: Elaborated by the authors.

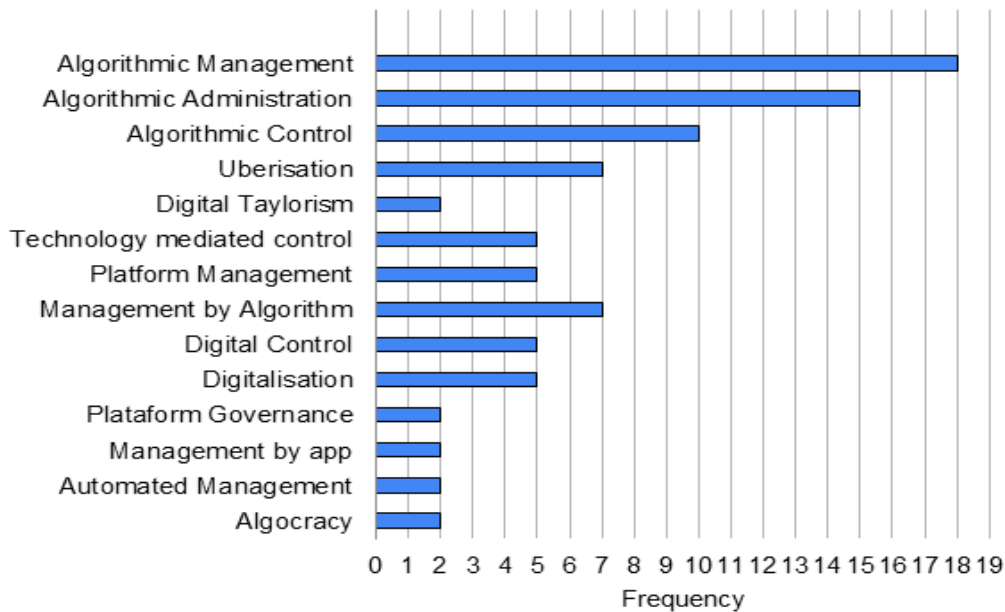
Among the studies we analysed, three articles were most cited: "Good Gig, Bad Gig: Autonomy and Algorithmic

*Control in the Global Gig Economy*”, with 578 citations, written by Wood *et al.* (2019) published in the magazine *Work, Employment and Society*. The article assesses the quality of work on digital platforms in Sub-Saharan Africa and South-east Asia and details how on-line work is shaped by algorithmic control. Among the many issues, the authors highlight that control mechanisms can lead to low income, social isolation, non-social work and irregular schedules, overworking, sleep deprivation and exhaustion.

The second most cited article was “*Digital labour and development: impacts of global digital labour platforms and the gig economy on worker livelihoods*”, cited by 390 authors. In this article Graham *et al.* (2017) and published in the magazine *Transfer: European Review of Labour and Research*. The article highlights four concerns for digital platform workers: bargaining power, economic inclusion,

intermediate value chains, and upgrading. The authors argue that despite important and tangible benefits for a range of workers, there are also a range of risks and costs that unduly affect the livelihoods of digital workers and their working conditions.

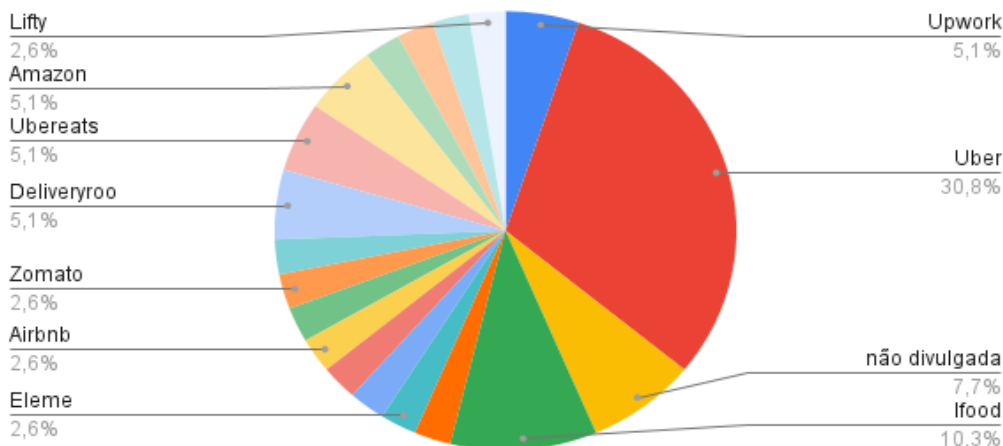
The third most cited publication was “*The sharing economy: labour, inequality, and social connection on for-profit platforms*”, published by *Sociology Compass*, with 239 citations by Schor and Attwood-Charles (2017). This article approaches three aspects of sharing economy: social connection, work conditions and inequalities. In addition to exploring the aspects of ethnic discrimination on the platform Airbnb, it was possible to observe that the words used in the field are diffuse despite discussing the same or similar phenomena. The frequency of words found in literature are seen in Figure 2:



**Figure 2.** Words found in the literature review.  
Source: Elaborated by the authors.

The most recurrent word was algorithmic management, which was used by many researchers after the introduction by Lee *et al.* (2015). However, there are attempts to redefine it (Möhlmann & Zalmanson, 2017). In total, Figure 2 presents 14 different words found in the

literature among which only 7 were used by more than one author. This finding indicates that the field is still developing and needs to bring clarity to the current state of art about these issues. As to the platforms investigated in the study, an overview is seen in Figure 3.



**Figure 3.** Main digital platforms described in the studies.  
Source: Elaborated by the authors.

The empirical research in this review, as shown in Figure 3, focused on these digital platforms: Uber and Ifood. Some articles did not name the platforms they researched, but specified the sectors they belong to: beauty and aesthetics platforms; housework platforms and transport/ride platforms.

The demographic data present general information about the 39 studies under investigation. To provide theoretical details to the analyses and outcomes of this literature review, the next subsections align the 39 studies to the context of the phenomenon, the research question, the limitations and the possibilities as well as the validation techniques used to increase their legitimacy and reliability. Regarding the quality criteria for the articles selected in this SLR, most articles used qualitative methods to analyse empirical data. Among the quality criteria used in those investigations, the most prominent were data triangulation (using more than once source of data) and interviews with experts.

#### 4.2 Analysis of the RSL

Algorithm mediated management was first described by the sociologist Aneesh (2009), who used the term algocracy, to contrast with other previous forms of organisation and as a reference to artificial intelligence that supports the model. Described as a management model based on coded and programmed algorithms to control labour processes (Aneesh, 2009). In turn, Lee et al. (2015) introduced the term algorithmic management. Despite the similarities between the two concepts, this author uses a denomination different from Aneesh (2009). According to Lee et al. (2015), algorithmic management is a practice where the software algorithms supplemented by technological devices perform functions normally executed by human managers. The authors used the word in the context of platforms like Uber and Lyft, the focus of the study. The word was used and discussed by many scholars in the field since then and its conceptualization was just the starting point.

Schildt (2016) based his conceptualization on the definition of Lee et al. (2015), but was the first to call it scientific management 2.0. Using this nomenclature, the author emphasised that management became a technology-executed process, rather than human conducted, in reference to Taylor's management theory, known for its strict rules and orientation toward maximum efficiency of operations. In his study, Schildt (2016) also states that scientific management 2.0 changes power dynamics of a hierarchy of managers for larger settings of professionals that rule over analysis, programming and business. In the following year, Möhlmann and Zalmanson (2017) presented their own concept for the phenomenon. Based on his comprehensive study about Uber drivers and their work experience, the researchers redefine algorithmic management as a supervision, governance and control practice, conducted by software algorithms over many on-line workers. These authors contradict Lee et al. (2015), as

they advocate that algorithmic management cannot be conceived on the grounds of human management practices. Rather, workers are constantly monitored and evaluated, while decisions are implemented automatically based on the collected data, instead of relying on decisions by human managers (Möhlmann & Zalmanson, 2017). Despite the contribution, it is possible to observe that the definition proposed by Lee et al. (2015) is still prominent in the field.

Wiener et al. (2020) also discovered and introduced their own interpretation of the concept. They named the same phenomenon Technology Mediated Control (TMC) considering that algorithms control the labour processes. This definition is related to the use of advanced digital technologies, sensors of the Internet of Things, apps, wearable devices and smart algorithms in management to influence workers to behave in a certain way according to organisational expectations. The authors claim that this concept is much more aligned to the previous definitions of algorithmic management of Lee et al. (2015) and Möhlmann & Zalmanson (2017). According to Wiener et al. (2020), there are two types of TMC: one that supports an organisation management; and the other that automatizes it, like Uber, iFood, Rappi, etc. For the authors, the latter type is a basic representation of algorithmic management practices.

Mateescu and Nguyen (2019) define algorithmic management as a diversified set of tools and technological processes that structure working conditions and manage the work force on-line. The study explains the phenomenon as the replacement of humans who direct and supervise workers with technology. They also specify that systems of algorithmic management are effective to phase operations, as they are capable of monitoring and coordinating great activities of the work force along with data use to optimise workers and reach the desired results, such as the cost of labour.

Duggan et al. (2019) define algorithmic management (or management by algorithm as they also call it) as a system of control algorithmic management as a system of control where self-learning algorithms are given the responsibility for making and executing decisions affecting labour, thereby limiting human involvement and oversight of the labour process. In this system, algorithms are used to undertake typical HR processes like work assignment and performance (Duggan, et al., 2019). Because this is a relatively recent phenomenon with a handful publications, and due to the quantity and variety of definitions, there are certain ambiguities in the field. The main reason for that is the fact that nowadays, there are many different platforms that go from offering rides and house sharing to freelance platforms and food delivery. All of these have differences in terms of how they are projected and how processes are executed. However, to a certain degree, there is no clear distinction between them, including the term algorithmic management, used by Cheng & Foley (2019) in a study about Airbnb with no characteristics of actual labour.



Jarrahi et al. (2019) were among the first in the field to approach such inconsistency and develop a different concept, which they named platform management, separating it from algorithmic management and focusing exclusively on platforms where knowledge-intensive labour is produced, for example, the freelancer platform Upwork. The study shows the lack of research on how management is organised on this type of platform, considering they dispose of an entire support department with real employees, who execute certain managerial functions through technology – which Jarrahi *et al.* (2019) outline in their study.

Algorithmic management is fundamentally shaping labour processes and performance management on digital platforms (Heeks et al., 2021). The algorithmic correspondence between workers with assignments and clients is often due to characteristics like classification, clients' evaluation, cancellation or hiring fees and levels of qualification (Fielbaum & Tirachini, 2021). Simultaneously, in some internet-based platforms, some of these features can be bypassed by paying extra fees, creating obstacles to the access of workers labour, who may not dispose of financial means to pay those fees and improve their classifications or evaluation scores (Graham et al., 2020; Heeks et al., 2021). Another well debated aspect of algorithmic management are the surveillance tools where the software tracks the keyboard entries or screen shots at random intervals in many internet-based platforms, limit workers' freedom and autonomy from screenshots at random intervals (ILO, 2021; Vieira, 2020). Similarly, in transportation platforms, surveillance used GPS and acceptance or cancellation fees, that could generate low scores, affect access to work and even deactivate the worker's account (Anwar, et al., 2021).

The governance of platforms, despite lacking formal contract, relies on increasingly more sophisticated devices to control and supervise workers. The terms of service, unilaterally defines, gives platforms a considerable control over workers in the performance of their activities and can even limit the communication between workers and clients or organisations through exclusivity clauses, for example – that demand the use of the platform as their sole work platform for 24 months (such as Upwork and 99designs) (Fagioli, 2021; Graham et al., 2020; Heeks et al., 2021; Myhill et al., 2021).

The variety of definitions and non-use of terms show that the field is going through formulation and establishment. The same is true for research perspectives to explore algorithmic management and digital labour platforms. In addition, research on the quality of work on digital platforms is still limited in both the number of studies and the range of platforms and countries investigated (ILO, 2021).

## 5 DISCUSSIONS

The present SLR identified 39 studies, among which the studies of Sutherland and Jarrahi (2018), Jarrahi et al.

(2019) and Altenried (2020) stand out as they explored algorithmic management using the perspective of sharing economy to look into digital labour platforms. Sutherland and Jarrahi (2018) discovered the recent appearance of the concept of sharing economy. The authors divided the current literature into two categories: centralised and decentralised platforms. For a centralised platform or a centralised model of mediation in sharing economy, there is a strong authoritarian presence of “technology” in interactions and exchanges between the platform participants (areas of concentration: surveillance, control, algorithmic, management). The decentralised platforms instead serve mostly for matchmaking. The studies on this category concentrate on humanistic issues (for example, altruism, sustainability) rather than on the technology embedded in the platform (Sutherland & Jarrahi, 2018).

Jarrahi *et al.* (2019) advanced the concept of platform management further and, more importantly, distinguished the concept from algorithmic management. In their research, they focused explicitly on the platform Upwork, which holds unique features regarding the organisation of labour, compared to other types of labour enabled to the platform (Uber or Amazon Turk) and, consequently, has different management mechanisms (Jarrahi, et al., 2019). One of the study's conclusions is that Upwork practices are similar to many functions of human managers (allocating resources), which is not present in algorithmic management. This is a different concept named platform management (Jarrahi et al., 2019). Furthermore, although servers of knowledge-intensive labour also have control over data, like in algorithmic management, what creates power asymmetry for workers on Upwork is the power to negotiate with clients and bypass the platform's policies.

The theoretical fundamentals used by Jarrahi et al. (2019) to conceptualise platform management explored algorithmic management, their main attributes and the challenges incorporated in labour. As a result of the study, they identified six main functions of platform management in the context of intensive knowledge labour platforms: transaction management (structure plus automation), channelling communications (not under control of algorithmic management), conflict resolution, information supply (better correspondence of algorithms and general guidelines), performance evaluation (integrated client plus algorithmic measure) and policies and restrictions.

In the study by Altenried (2020), the phenomenon was explored from the perspective of collective work (also mentioned as platform or digital labour), triggering the denomination of digital Taylorism (in accordance with some of the perspectives discussed previously). This fact argues that technology allows for new surveillance methods, standardisation and disintegration through total or partial automated management, control and cooperation – the use of algorithms. According to Altenried (2020), aspects of work like specific and constant mediation and surveillance via technology along with strict behaviour rules employed in the platforms are direct examples of strategies that affect working conditions negatively.

Working conditions and HR practices are additional aspects identified in the analyses of articles in our SLR. Duggan *et al.* (2019) were among the first in the field of Resource Management to suggest that HR practices organisation were explored on labour platforms and with algorithmic management. To bring clarity onto the existing platforms and to work with them, the authors make their own distinction of the different types of platform-based employment and work.

Using the example of hired work, platform work was divided into three categories: capital platform work (Airbnb, Etsy), Crowdfork (Amazon Mturk, Upwork) and work on demand (Uber, Foodora). Capital platform work can be described as a digital platform to sell goods point by point, where the role of the platform is to connect clients to certain resources (form of capital) offered by individuals. A distinguishing feature of these platforms is the absence of actual work performed by individuals, since the underutilised resources or assets are shared between the owner, the client and the platform, becoming an asset-based service (Duggan *et al.*, 2019; Vieira, 2020; Fielbaum e Tirachini, 2021). These platforms are usually associated with sharing economy and with algorithmic management, although they represent a totally different practice and a way to earn money. Crowdfork means that workers remotely complete tasks through a platform. It is noteworthy that collective work can be divided into smaller categories: Cloud-based (tasks can be completed remotely via the Internet); crowdwork (the task is given to an undefined group of people online), micro-tasking (he task is further subdivided into smaller units for piecemeal work); contest-based crowdwork (a large group of individuals concludes the task, while in the end only one result is used and paid for) offered directly to individuals using the freelancer market (such as Upwork, AMT, Clickworker, CrowdFlower and Microworkers). Work on demand refers to service-providing intermediary digital platform organisations that utilise workers to perform tasks locally (driving or delivery) with the organisation retaining a percentage of the exchange (Duggan *et al.*, 2019).

Duggan *et al.* (2019) showed the role of algorithmic management in the context of work on demand and explored the functions of human resource management mediated by technology in that context. They also mention the similarity to Taylor's and Ford's management model. They also explained that, according to theory of organisational support, workers perceive HR practices (performance management and task assignment) as determining for the commitment and support of the organisation. Therefore, in algorithmic management, these practices are automated and oblique for workers (Vieira, 2020; Polkowska, 2019; Altenried, 2020; Jarrahi *et al.*, 2019; Sutherland, & Jarrahi, 2018). Research on the quality of work provided by online platforms is still limited in both the number of studies and the range of platforms and countries investigated (ILO, 2021; Rani & Furrer, 2021).

Therefore, the present SLR achieved the goal that consisted of understanding algorithmic management on

digital work platforms, providing new insights for an expanding field with scarce literature on the applicability of this management model on digital work platforms. This systematic review contributes: (1) to provide a general descriptive perspective on algorithmic management, (2) to identify or to analyze the main concepts in the debate concerning algorithmic management and (3) to create a theoretical structure of the main authors about a certain subject.

## 6 FINAL REMARKS

Observing the current literature on algorithmic management, we can conclude that, at the moment, there is a conceptual polysemy since the concept has been used in different scientific fields according to their own perspectives. First, there is a mismatch between current concepts, some researchers conceive algorithmic management as a practice where power and control are in the hands of software (Fagioli, 2021; Lee *et al.*, 2015; Mateescu & Nguyen, 2019; Möhlmann & Zalmanson, 2017; Wood, *et al.* 2019). Some other researchers, however, understand that technology conveniently transfers such power from the hands of managers to other interested parties inside the organisation (Schildt, 2016; Wiener, *et al.*, 2020). The lack of an accurate definition of the word brings confusion to the field, making it a polysemic concept.

Originally, the term algorithmic management was proposed and created by Aneesh (2009), followed by Lee *et al.* (2015), still a reference in the subject due to his research about Uber. However, other on-line labour platforms have not been recognised and distinguished from one another in this research perspective, which led the term to be used for Airbnb, where there is no actual labour (Cheng & Foley, 2019; Heeks *et al.*, 2021). Therefore, there are continuous innovations and developments.

A recent deviation is the platform management, introduced by Jarrahi *et al.* (2019), that approach these contextual aspects and summon other researchers to consider the platform in question in regard to algorithmic management. Other examples include compete innovations, based on a different conceptualization approach for the issue of Algorithm Mediated Technology (Wiener *et al.*, 2020; Wu e Li, 2019; Anwar *et al.*, 2021) or the total absence of the concept in the study despite the description of characteristics (Sutherland & Jarrahi, 2018). Nonetheless, the analysis of current research evidence about this new management practice makes it possible to formulate provisory definitions about algorithmic management. Algorithmic management can be conceived as a set of strategies used by organisations to force workers (coercively) to follow rules. Among the characteristics are the responsibility for control and distribution of labour, lack of interest in feedback and use of financial and non-personal incentive, in the form of gamification to motivate employees to continue working.

The nature of the practice aims to keep workers online, to monitor their development and behaviour, assigning work and paying for it according to the data. The only element that can be perceived as beneficial to workers is the ease of joining a platform and the capacity of working immediately. As for the issues, the lack of trust on the algorithm manager is one the most cited in the literature. For workers, there is no clarity in the evaluation of their development and the reasoning behind the decisions of the system in general (Duggan et al., 2019; Sun, 2019; Polkowska, 2019). To follow the system and adopt its leadership, it is necessary to establish a high level of cognitive trust (Glikson & Woolley, 2019).

The present review provided an outline of the state of the art to a better understanding of algorithmic management in digital labour platforms. We explored the emerging concept of algorithmic management and their effects in the work conditions on digital platforms, in other words, the automation in different levels of management (average and superior). Hence, we can conclude that explaining the concept is very challenging purely based on research evidence, since there is a variety of perspectives and interpretations of both practices.

These were the limitations identified in the studies analysed in the present SLR: lack of longitudinal studies that compare the work of digital platforms at different intervals or even the impact these platforms have on labour. It was also verified that most studies report labour in the global North, hence the need to approach the global south in platform economy, given the specific issues regarding labour and market that are not found in northern countries. Another limitation concerns the approach of the subject by several research perspectives and not all were included in this SLR. Therefore, publications that focus on legal issues of labour on platforms and how they are solved were excluded from the corpus. Similarly, minor issues, such as algorithmic hiring, were not included in the SLR since it was not relevant for our focus on most general practices of organisation management and their mediation via automation technologies.

A specific literature review is necessary to approach ethical issues and solutions in AI based decision making systems since these are parallel issues but of great relevance to the ones approached presently. Due to resource limitations, articles about technology resistance and adoption of technology were not included in the review, except for those focused on the likely resistance to implications of IA leadership/management. In general, the research field is still restricted to Information Technology, Information Systems, computation sciences and corporate management, which makes research challenging. The Business field has produced few works focused on algorithmic management practices on digital labour platforms and the impacts of this new management model in working conditions to decent/dignified labour. As we advanced in the systematic literature review; it was possible to identify new insights that might answer some questions in

future research. Therefore, we propose topics for future investigations based on the gaps in the literature:

- Analyse algorithmic management in the various types of platforms to investigate comparisons and differences;
- Expand the study of algorithmic management onto digital platforms in the global South;
- Study algorithmic management to specific issues of genre and ethnicity in digital platforms;
- Analyse the issues and the possible solutions for algorithmic management in digital labour management;
- Analyse the benefits of algorithmic management for each interested group on digital labour platforms;

This review contributes both to the formulation of definite explanations of terms and to the orientation of new research. To summarise the discussion and the answer to our research question, although algorithmic management is, presently, an example of almost complete mediation of human management by technology, it still lacks efficiency and comes with plenty of inconveniences. Despite working for platform organisations like Uber, it is not something that most traditional organisations would implement on a large scale (total management of the workforce).

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