Yönetim Bilimleri Dergisi/Journal of Administrative Sciences
Cilt/Volume: 22, Sayı/No: Özel Sayı/Special Issue, ss./pp.: 1782-1806
DOI: https://doi.org/10.35408/comuybd.1516492

-RESEARCH ARTICLE-

IN TERMS OF ORGANIZATIONAL BEHAVIOR A BIBLIOMETRIC RESEARCH OF LEADERSHIP 4.0 WHICH IS A REFLECTION OF INDUSTRY 4.0*

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Abstract

The Industry 4.0 revolution refers to the digital transformation of industry. The significance of the Industry 4.0 revolution is further enhanced by the advent of new technologies concomitant with this revolution. The technologies of Industry 4.0 include artificial intelligence, the Internet of Things, big data, and cloud computing. Organizations that adopt these technologies can adapt to the Industry 4.0 revolution and gain a competitive advantage. By means of Industry 4.0 technologies, it is possible to save resources used in production and to produce products with better quality and different features. Organizations that fail to leverage these technologies will be unable to reap the benefits of the Industry 4.0 revolution, potentially leading to a disadvantage in the competitive landscape. It is therefore crucial for organizations to adopt Industry 4.0 technologies. It is imperative that employees possess the requisite knowledge, skills, and abilities to utilize Industry 4.0 technologies. Those in leadership positions are able to exert influence and direct the knowledge, skills, and abilities of employees. Consequently, the pivotal factor in the implementation of Industry 4.0 technologies within an organizational context is leadership. The concept of leadership 4.0 posits that leaders possess distinctive advanced knowledge, skills, and abilities that enable them to influence employees and facilitate the utilization of Industry 4.0 technologies within the organization. Leadership 4.0 serves as an indispensable conduit for the transfer of Industry 4.0 technologies within organizational settings. Leadership 4.0 plays a pivotal role in preparing organizations for the advent of industry 4.0. Consequently, the successful integration and utilization of Industry 4.0 technologies within organizations hinges upon the effectiveness of leadership 4.0. In this study, it is aimed to draw a conceptual framework for the researchers for future studies by addressing the bibliometric aspects of the studies on leadership 4.0 in terms of organizational behavior in the Web of Science (WOS) database. In accordance with the objective, a bibliometric analysis of the studies on leadership 4.0 in the WOS database was conducted using the VOSviewer program.

Keywords: *Industry 4.0, Leadership 4.0, Organizational Behavior, Bibliometric Analysis.*

JEL Codes: *D23, M12, M19.*

Başvuru: *15.07.2024* **Kabul:** *29.09.2024*

* This article is the revised full text of the paper presented as an abstract at the International Social Sciences Conference IV organized by Çanakkale Onsekiz Mart University between July 5-6, 2024.

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ENDÜSTRİ 4.0'IN YANSIMASI OLAN LİDERLİK 4.0'A ÖRGÜTSEL DAVRANIŞ AÇISINDAN BİBLİYOMETRİK BİR İNCELEME[2]

Öz

Endüstri 4.0 devrimi sanayinin dijital dönüşümünü ifade etmektedir. Endüstri 4.0 devriminin önemini artıran unsur devrimle ortaya çıkan teknolojilerdir. Yapay zeka, nesnelerin interneti, büyük veri, bulut bilişim, büyük veri gibi teknolojiler Endüstri 4.0 devriminin teknolojileridir. Bu teknolojileri kullanan örgütler Endüstri 4.0 devrimine uyum sağlayabilmekte ve rekabetçi avantaj sağlayabilmektedirler. Endüstri 4.0 teknolojileri sayesinde üretimde kullanılan kaynaklarda tasarruf sağlanabilmekte, daha kaliteli ve farklı özellikli ürünlerin üretilmesi mümkün olabilmektedir. Bu teknolojilerden yararlanmayan örgütler ise Endüstri 4.0 devriminin avantajlarından yararlanamamakta ve rekabette dezavantajlı olabilmektedirler. Dolayısıyla Endüstri 4.0 teknolojilerinin örgütte kullanılması örgütler için önem arz etmektedir. Örgütlerde Endüstri 4.0 teknolojilerini uygulayanlar çalışanlarıdır. Çalışanların da Endüstri 4.0 teknolojilerini kullanabilmeleri için gerekli bilgi, beceri ve yeteneğe sahip olmaları gerekmektedir. Liderler çalışanların bilgi, beceri ve yeteneklerini etkileyip yönlendirme gücüne sahiptirler. Bu nedenle Endüstri 4.0 teknolojilerinin örgütte kullanılabilmesinde kilit unsur liderliktir. Bu kapsamda Endüstri 4.0 devriminin liderliği olan liderlik 4.0 söz konusu olmaktadır. Liderlik 4.0 kavramı liderlerin Endüstri 4.0 teknolojilerinin örgütte kullanılabilmesi için çalışanları etkileyebilecek özel gelişmiş bilgi, beceri ve yeteneklere sahip olmasını ifade etmektedir. Liderlik 4.0, Endüstri 4.0 teknolojilerini örgüte aktarmada olmazsa olmaz bir köprüdür. Liderlik 4.0 örgütleri Endüstri 4.0'a hazırlamaktadır. Bu nedenle Endüstri 4.0 teknolojilerinin örgüte aktırılması ve örgütte başarılı bir şekilde kullanılması liderlik 4.0'a bağlıdır. Bu çalışmada Web of Science (WOS) veri tabanında örgütsel davranış açısından liderlik 4.0 ile ilgili yapılmış çalışmaların bibliyometrik açıdan ele alınarak daha sonra yapılacak çalışmalar için araştırmacılara kavramsal bir çerçevenin çizilmesi amaçlanmıştır. Bu amaç doğrultusunda WOS veri tabanında liderlik 4.0 konusunda yapılan çalışmaların bibliyometrik analizini yapabilmek için VOSviewer programı aracılığıyla analiz yapılmıştır.

Anahtar Kelimeler: *Endüstri 4.0, Liderlik 4.0, Örgütsel Davranış, Bibliyometrik Analiz.*

JEL Kodları: *D23, M12, M19.*

"Bu çalışma Araştırma ve Yayın Etiğine uygun olarak hazırlanmıştır."

1. INTRODUCTION

[2] Genişletilmiş Türkçe Özet, makalenin sonunda yer almaktadır.

In the contemporary era, organizations are endeavoring to adapt their technological resources, intellectual capital, and workforce competencies in alignment with the Industry 4.0 paradigm, with the objective of sustaining their competitive advantage (Akçay Kasapoğlu, 2018: 300). The Industry 4.0 revolution is defined as the rapid digital transformation in the design, production, and sale of products (Oberer and Erkollar, 2018). The concept of Industry 4.0 has been widely adopted globally over the past decade. A considerable number of countries have undertaken substantial initiatives with the objective of developing a strategic approach to the Industry 4.0 revolution (Xu et al., 2021: 530). The Industry 4.0 revolution offers countries and organizations the potential for economic, social, and environmental development. The technological elements of the Industry 4.0 revolution (such as artificial intelligence, the Internet of Things, big data, and cloud computing) also offer critical perspectives for future innovation and business growth. The utilization of Industry 4.0 technologies facilitates the efficient production of goods, the reduction of resource consumption, and the assurance of environmental sustainability. Industry 4.0 technologies facilitate the independent, time and network independent collaboration of production lines, business processes, and equipment (Javaid et al., 2022: 203).

The Industry 4.0 era has been marked by the most revolutionary technological advances. This has created new avenues for individuals to advance their careers and new prospects for manufacturers and entrepreneurs. These insights are of critical importance for increasing operational efficiency and reducing costs (Haleem, Javaid and Singh 2024: 1). Currently, technological development and innovation play a significant role in the majority of organizations. This is reflected in the increased competitiveness of any given organization, particularly in the context of Industry 4.0. The revolution is leading to potential fundamental changes in various fields that extend beyond the industrial sector. However, leadership is essential for the successful fostering of an innovation culture. Accordingly, leaders and their leadership style are of paramount importance in the transition to the Industry 4.0 revolution (Puhovichova and Jankelová, 2021: 1).

The integration and implementation of Industry 4.0 technologies into our daily lives is occurring at a rapid and seamless pace. These technologies are of paramount importance in the context of our current reality, which is defined by the pervasiveness of digital technologies. The growing expectation that Industry 4.0 technologies will facilitate positive opportunities for sustainability further underscores the importance of this concept. It is therefore incumbent upon academia to consider the implications of the Industry 4.0 revolution (Ghobakhloo, 2020: 2; Venkatesh, 2020: 2709).

The ongoing digitalization of production is creating new possibilities (Bach and Sulíková, 2021: 210). The global impact of technology has resulted in significant gains in productivity in the production sector. In order to enhance responsiveness to evolving customer demands and industry-specific circumstances, organizations have sought to advance their production systems in alignment with the Industry 4.0 paradigm. Given that the transition to the Industry 4.0 concept represents a strategic decision, it is essential to disseminate the strategy throughout the entire organization,

ensuring that training is provided at all levels, from the top management down to the operational staff. Such a transformation is feasible through effective leadership (Akçay Kasapoğlu, 2018: 300).

Although digital disruption is a pervasive phenomenon across nearly every industry, it is unfortunate that the strategies employed by leaders are not keeping pace with this rapidly evolving landscape. While some leaders are adequately prepared to effectively navigate the complexities of Industry 4.0, many leaders continue to demonstrate deficiencies in their preparedness (Venkatesh, 2020: 2709).

The impact of digital technologies extends beyond the realm of occupational endeavors. Furthermore, they are influencing the manner in which organizations are managed and the leadership styles that are employed. The changes brought about by the Industry 4.0 revolution necessitate the establishment of a leadership culture that aligns with the tenets of Industry 4.0. The advent of technology and the evolution of production processes with the advent of Industry 4.0 necessitate a transformation in leadership style (Bianco et al., 2023).

The term "leadership 4.0" is used to describe the style of leadership that is appropriate in the context of the Industry 4.0 era. Leadership 4.0 is concerned with the identification and implementation of solutions that enhance profitability, productivity, and customer satisfaction within the context of organizational management. Leadership 4.0 can be employed as a sequential process to maintain the organization's position at the forefront of technological advancement (Oberer and Erkollar, 2018).

Leadership 4.0 entails more than the mere ability to oversee the implementation of novel technologies within an organizational setting. It is incumbent upon leaders to possess the capacity to incorporate employees into this process while integrating new technologies into the organization. Consequently, during the implementation of new technologies within an organization, it is imperative to guarantee the acceptance and appropriate utilization of these technologies (Molino, Cortese and Ghislieri, 2021: 4).

It is incumbent upon leaders to gain an understanding of the impact that AI will have on their industry and organization. Leadership 4.0 is predicated on the cultivation of an open and innovative culture that is capable of adapting to changing conditions. Those who are effective in their digital leadership roles are able to manage the ever-changing interaction between managers, people, computers, and processes. Furthermore, they consistently promote the exchange of knowledge, collaboration, and innovation (Haleem, Javaid and Singh, 2024).

Consequently, it can be concluded that the Industry 4.0 revolution is a pivotal factor in enabling organizations to gain a competitive advantage. It can be argued that the deployment of Industry 4.0 technologies by organizations is a crucial undertaking, and this is feasible through the actions of leaders. This is due to the fact that leaders act as intermediaries in the transfer of these technologies. In this context, the concept of leadership 4.0, which refers to the leadership style of leaders in accordance with

the Industry 4.0 revolution, is a pertinent issue for consideration. Conversely, as it is the employees who utilise Industry 4.0 technologies within the organisation, it is imperative that their knowledge, skills and abilities are aligned with the capabilities required to operate these technologies effectively. Given that leaders possess the capacity to influence and direct the equipment of employees, it is incumbent upon them to direct employees to utilize these technologies. This study endeavors to conduct a bibliometric analysis of the concept of leadership 4.0 in the context of organizational behavior. The absence of any prior study on this subject in the existing literature renders the current study a singular contribution to the field. As a consequence of the analysis, recommendations have been formulated for practitioners and researchers on leadership 4.0.

2. LITERATURE REVIEW

2.1. Industry 4.0

As defined by The Turkish Language Association (TDK), the term "industry" is synonymous with the term "industrial process." In essence, it encompasses the entirety of techniques and tools utilized to transform raw materials and generate energy resources (TDK, 2024). Industry, which constitutes a sector of the economy, denotes the manufacture of material goods since advanced mechanization and automation (Lasi et al., 2014: 239). The concept of industry is considered in four distinct historical periods. The advent of steam or water-powered machinery constituted a disruptive innovation in the context of manual production during the initial phase of the Industrial Revolution. In the second industrial revolution, a high level of efficiency was achieved through the utilization of electricity in production and the implementation of modern production lines. In the third industrial revolution, the advent of computer and communication technologies precipitated the advent of automated production. In the fourth industrial revolution, the use of cyber-physical production systems enabled the implementation of intelligent decision-making processes, the achievement of mass production efficiency, and the production of personalized high-quality products through real-time communication and collaboration (Xu et al., 2021: 530).

One may define the first industrial revolution as a period of mechanization, the second industrial revolution as a period of intensive electrical energy usage, and the third industrial revolution as a period of widespread digitalization (Lasi et al., 2014: 239). The fourth industrial revolution can be defined as a period of fully connected and automated production, which may be described as the trend towards the smart factory (Akçay Kasapoğlu, 2018: 300). The fourth industrial revolution is also referred to as Industry 4.0. The concept of cyber-physical systems emerged in 2011 as part of a project at the Hannover Fair, representing the high-tech strategy of the German state (Ghobakhloo, 2020: 1; Oberer and Erkollar, 2018).

For organizations to derive optimal benefit from Industry 4.0 technologies, it is essential that they invest in the development of talent in the areas of data connectivity,

analytical intelligence, and human-machine interaction (Oberer and Erkollar, 2018). It is incumbent upon organizations to make the requisite adjustments to their digitalization strategies in accordance with the advent of Industry 4.0. It is incumbent upon leaders to take stock and reassess their business processes to maintain competitiveness in the future (Behie et al., 2023: 317).

The contemporary business environment is undergoing a rapid transformation as a consequence of technological advancement and digital transformation. The advent of digital technologies has resulted in a radical transformation of business processes, communication, and resource management. Although the Industry 4.0 revolution primarily concerns the integration of physical and digital systems, technologies such as artificial intelligence, big data analytics, and the Internet of Things have been incorporated into industrial processes, thereby transforming the process of transportation from production to consumers. Digital transformation is not merely a technological process; it also necessitates leadership and organizational change. It is the responsibility of leaders to guide organizations through this transformation, to adopt new technologies, and to successfully manage change (Mert, 2024: 119).

The impact of technological advancements, collectively termed "Industry 4.0," is becoming increasingly evident across a multitude of sectors, including social sciences, finance, the economy, and business (Mil ve Dirican, 2018: 2). The implementation of Industry 4.0 cannot be achieved through the mere introduction of new technologies. It is similarly essential to direct attention towards the manner in which novel technologies will be integrated into the business and how they will function in unison with the system (Kamber ve Sönmeztürk Bolatan, 2019: 839).

For organizations to achieve success, it is essential to consider not only the technological aspects of Industry 4.0, but also the role of leadership styles in this context. It is imperative that organizations adopt Management 4.0 to identify and implement suitable technologies in the Industry 4.0 era. The leadership styles adopted by organizational managers play an instrumental role in the success of the organization. Consequently, organizational managers must adopt leadership styles that will ensure success in the context of Industry 4.0 (Cinnioğlu, 2020).

The ability to effectively manage the dynamic interaction between machines, technology, and people in the new work environment is a crucial competency for digital leaders. It is anticipated that leadership 4.0 will cultivate an open and innovative culture that is receptive to change and progress. This will encourage and inspire teams to adapt to ongoing changes in the market (Haleem, Javaid and Singh, 2024: 1).

The characteristics of the Industry 4.0 revolution can be enumerated as follows (Haleem, Javaid and Singh 2024; Javaid et al., 2022; Xu et al., 2021; Ghobakhloo, 2020):

1. The concept of smart production is being re-examined.

2. It offers a sustainable solution.

3. It is a strategic decision for organizations.

4. The interactions between humans, machines, and technology occur simultaneously, irrespective of spatial and temporal constraints.

5. It is possible to achieve savings in the production process.

6. The advent of Industry 4.0 necessitates the implementation of a centralized leadership structure.

2.2. Leadership 4.0

In the 21st century, leadership has become one of the primary instruments for attaining organizational objectives. The 21st century is an age of information and technology that plays an active role in human life. It is a period of rapid change and development, with new developments emerging on a daily basis. These changes and developments have had an impact on the characteristics of the leader that group members follow. While an autocratic and sovereignty-based leadership approach was dominant in the period preceding the first industrial revolution, a scientific leadership approach was adopted from that point until the advent of Industry 4.0. During this period, the definition of leadership has undergone significant transformation, evolving towards a more democratic and participatory approach. This shift has been accompanied by a greater transparency in modern management styles (Varışlı, 2021: 63-64).

The concept of leadership 4.0 emerged because of Industry 4.0 and represents a novel paradigm in the field of leadership studies. The leadership 4.0 paradigm is predicated on the assumption that leaders can anticipate and discern future trends and developments, and subsequently influence and direct their followers in a manner that aligns with these anticipated outcomes (Baytekin ve Ata Çiğdem, 2020: 201). In essence, leadership 4.0 signifies leadership within the context of the Industry 4.0 era. Additionally, there is a necessity to cultivate a leadership 4.0 culture within organizational frameworks (Oberer and Erkollar, 2018).

The concept of leadership 4.0 represents one of the neologisms that have emerged in the wake of the Industry 4.0 revolution. The term "leadership 4.0" is used to describe the unique and advanced skills of leaders in navigating the challenges and opportunities presented by the Industry 4.0 revolution. This encompasses both the functioning of the organization and the creation of strategies for employee participation (Molino, Cortese and Ghislieri, 2021: 4). Leadership 4.0 should be a reactive type of leadership that encourages experimentation with new technologies, embraces change, considers feedback from collaborators, and guarantees opportunities and resources for continuous learning (Kelly, 2019).

The success of an organization's transformation into an Industry 4.0 entity is contingent upon its leadership's ability to adapt to the demands of the Industry 4.0 era.

The key attributes of leadership 4.0 include communication, knowledge and understanding, well-defined standards and methods, coaching, expectations, openness and transparency, trust, employee focus, and a culture of failure. In leadership 4.0, the leader must possess a range of competencies, including cognitive, business, interpersonal, and strategic skills (Puhovichova and Jankelová, 2021). Considering the pervasive influence of digital technologies across the entire organization, the advancement of digital strategies hinges on the presence of robust leadership at all levels of the organization (Haleem, Javaid and Singh, 2024: 1). It is therefore essential to disseminate the qualities associated with leadership 4.0 throughout the entire workforce, rather than limiting this to the executive level (Karademir ve Özgeldi, 2022: 2863).

Leadership 4.0 can be defined as a form of digital leadership that can foster the development of effective teams, maintaining a sense of connection and cohesion among team members, embracing the potential risks associated with innovation, and cultivating a culture of continuous improvement. Leadership 4.0 represents a significant advancement in organizational response to the transformative changes brought about by the advent of Industry 4.0. In essence, leadership 4.0 entails leaders formulating their own digital transformation strategies in alignment with their organizations' overarching business and growth plans (Baytekin ve Ata Çiğdem, 2020: 204).

The digital transformation triggered by the Industry 4.0 revolution is not merely a technological phenomenon; it also engenders profound alterations in the processes and organizational structures of organizations. As many organizations are still in the initial stages of their digital transformation, there is currently no consensus on the definition of digital leadership or a standard digital leadership model (Klein, 2020: 883).

The Industry 4.0 revolution necessitates not only leadership with established characteristics (chiefly relational abilities), but also novel competencies to navigate the digital and automated landscape with efficiency, with a particular emphasis on training, innovation, and change management. Consequently, leadership 4.0 can facilitate adaptation to the Industry 4.0 revolution, reconcile chaos and unpredictability with the stability of organizational processes, and lead to fundamental discoveries and innovations to maintain pace with technological progress and global competition (Molino, Cortese and Ghislieri, 2021: 4).

The objective of leadership 4.0 is to facilitate the development of digital transformation strategies by leaders, ensuring their alignment with the organization's business and development goals. This is achieved by successfully exemplifying disruptive digital leadership traits, including emotional and social intelligence capabilities such as empathy and relationship management, cognitive readiness, critical thinking, creative thinking, agility, and flexibility. The concept of leadership 4.0 is being increasingly employed by academics and consultants to describe the novel leadership style that is required for Industry 4.0 (Haleem, Javaid and Singh, 2024: 1).

2.3. Organizational Behavior

The term "behavioral sciences" encompasses all scientific disciplines that seek to explain or understand human behavior (Şimşek, Çelik ve Akgemci, 2014: 21). In today's dynamic societies, where continuous changes are experienced in the structures and functioning of organizations, it is becoming increasingly challenging to understand and evaluate the behaviors of individuals, groups, and organizations as a whole (Karabey ve Kerse, 2019: ix). In light of the ongoing process of globalization and the social events that are driving change, it has become imperative for businesses to prioritize the work behaviors of their employees and adopt certain concepts that will enhance the organization's effectiveness in order to survive in the increasingly competitive environment (Gümüştekin ve Güler, 2023: xiii).

Organizational behavior is a field of study that draws upon the insights of disciplines such as psychology, sociology, and cultural anthropology to understand the behaviors, perceptions, values, and learning capacity of individuals within organizational contexts. It examines human behaviors, attitudes, and performance at the organizational level and investigates the influence of external environments on organizations and their human resources, goals, missions, and strategies. Organizational behavior is a field of study that seeks to comprehend the actions and interactions of individuals within an organizational setting, anticipate future behaviors, and regulate those behaviors deemed necessary for the optimal functioning of the organization. It examines human behavior in the context of the workplace, investigating the influence of the organization on the individual and the ways in which individuals adapt their behavior in response to organizational factors (Şenturan, 2014: 1).

Today, it would not be wrong to associate two very important concepts with the ability of successful organizations to gain increasing competitive advantage and maintain a strong presence in the marketplace. These concepts are effectiveness and efficiency. Effectiveness and efficiency in organizations put people first. Because people are both a resource for the organization and the main factor that captures all other resources and directs them in line with the organization's objectives. Therefore, the importance of human relations, in other words, understanding people, finding the reasons behind their behaviors and directing these behaviors in the desired direction clearly emerges in order for organizations to be structured correctly, managed correctly and successful by achieving their objectives (Can, Aşan Azizoğlu ve Miski Aydın, 2015: 5).

Organizational behavior is a field of study that seeks to comprehend and elucidate the actions of employees within an organizational setting (Cankurtaran, 2023: 116). The discipline of organizational behavior is concerned with achieving success by examining the implementation of organizational resources, opportunities, and due care to enhance individual efficiency and effectiveness (Yavan, 2016: 279). Organizational behavior is the scientific and systematic examination of the feelings, thoughts, behaviors, and actions of individuals within and surrounding the organization (Yılmaz, 2019: 83).

3. METHODOLOGY

A bibliometric analysis is defined as a quantitative study of bibliographic material (Merigó and Yang, 2017: 37). It provides a means of understanding academic trends using visualization. Bibliometrics offers quantitative insights into country, author, university, and journal productivity; research strengths and weaknesses; literature gaps; collaboration networks; potential opportunities; and the widespread impact of outputs produced in a field. Furthermore, it can be employed as a preliminary stage of a systematic literature review. One of the reasons for its current prominence is that it can be employed as a preliminary step in any research project (Dirik, Eryılmaz ve Erhan, 2023: 168). It is a popular and rigorous method for researching and analyzing large volumes of scientific data. It reveals the development of a concept and sheds light on emerging areas related to the concept (Donthu et al., 2021: 285).

Bibliometrics is defined as a quantitative method that employs mathematical and statistical techniques to analyze books, journals, conference proceedings, and other written communications. The bibliometric approach allows for the observation and evaluation of data related to the progress of studies published in a scientific field through the use of basic or advanced statistical techniques, including citations, author links, keywords, themes discussed, and methods employed (Çavuşgil Köse, 2020: 101).

It is indubitable that academic publications and journals occupy a significant position with regard to the communication, accessibility and sharing of scientific data and information, given that they contain the most up-to-date data and information on various branches of science. An examination of the journals that facilitate scientific communication at specific points in time allows for the identification of trends and the assessment of popularity, as well as the delineation of the trajectory of academic studies within the period under consideration. Furthermore, it offers a forum for discussing the challenges encountered during this process and the strategies devised to address them. One such method is bibliometrics (Durgut ve Küçüksille, 2021: 2). This section will present a discussion of the research, data, and analysis conducted within the scope of this title.

3.1. Purpose of the Study

The specific tenets of leadership philosophies may vary in accordance with the prevailing cultural norms or historical context. A new set of leadership skills, designated as "leadership 4.0," is required to address the technological and economic changes brought about by the Industry 4.0 revolution (Haleem, Javaid and Singh 2024: 2). In this study, it is aimed to draw a conceptual framework for the researchers for future studies by addressing the bibliometric aspects of the studies on leadership 4.0 in terms of organizational behavior in the WOS database.

3.2. Data and Analysis

This study employed the WOS database. A search was conducted on June 28, 2024, utilizing all fields and the key concept of "leadership 4.0" resulting in the identification of 13 studies. The data obtained was subsequently analyzed using the VOSviewer program.

4. FINDINGS

In this section, the concept of leadership 4.0 will first be discussed in terms of all fields, and then the concept of leadership 4.0 will be discussed in terms of organizational behavior.

4.1. Leadership 4.0 from the Perspective of All Domains

4.1.1. Co-authorship of Authors

A network map was constructed based on the co-authorship analysis of the authors, which entailed identifying the most connected and collaborative authors by determining at least one publication and at least one citation criterion. In the cluster, it was observed that one of the authors had no connections, four had one, nine had two, four had three, five had four, six had five, and seven had six connections. However, those with one link received the highest number of citations (82 and 26). Figure 1 depicts the co-author analysis network map.

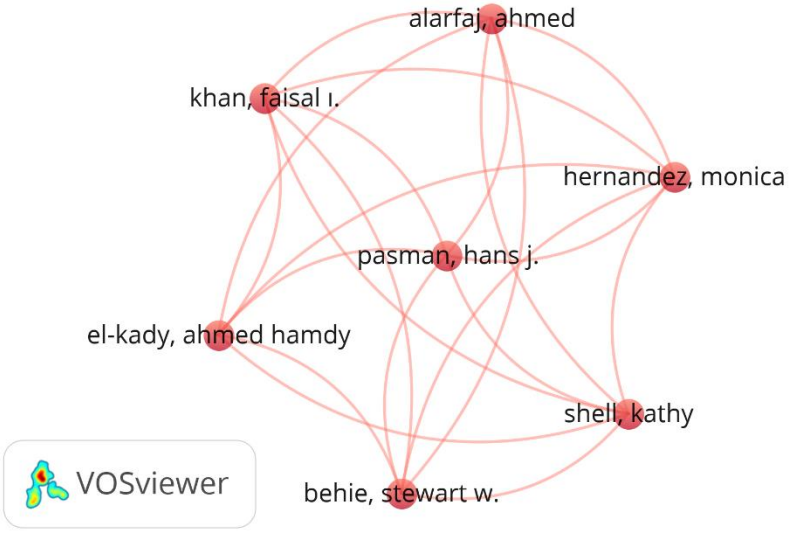

Figure 1: Co-Author Analysis

4.1.2. Citation of Authors Analysis

To identify citation networks, a network map of author citation analysis with at least one publication and at least one citation criterion was created. The most cited authors are Alptekin Erkollar with 82 citations, Birgit Oberer with the same number of citations, Paul Drews with 26 citations and Julia K. Eberl with the same number of citations. Figure 2 shows the authors' citation analysis network map.

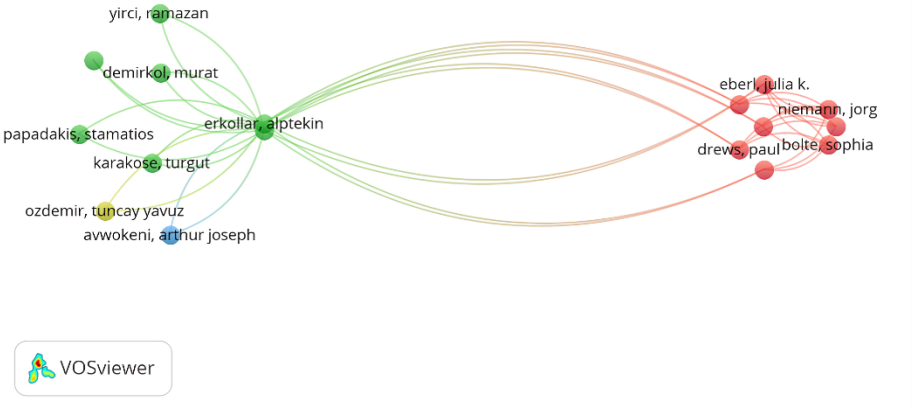

Figure 2: Authors' Citation Analysis

4.1.3. Citation Analysis of Countries

To construct a network map of the citations received by publications according to their country of origin, an analysis was conducted on eight observation units that are related to each other within the scope of the criteria of publishing at least one work by a country and receiving one citation. The countries with the highest number of citations were Turkey (96 citations), Germany (55 citations), and Greece (15 citations). With regard to the number of publications, Germany (three publications) and Turkey (two publications) were the most prolific. Figure 3 depicts the citation analysis network map of countries.

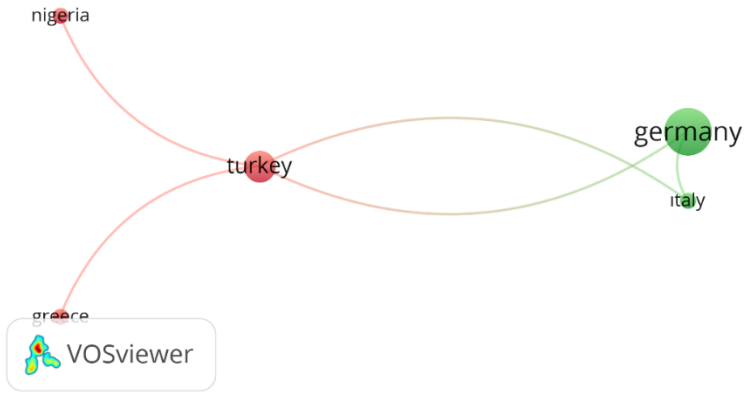

Figure 3: Citation Analysis of Countries

4.1.4. Citation of Organizations

In order to construct a network map of inter-institutional citations, an analysis was conducted on 18 observation units that met the criteria of publishing at least one work by an institution and receiving one citation. The institutions with the highest number of citations were Sakarya University (82 citations), Leuphana University of Luneburg (26 citations), and Karlsruhe Institute of Technology (16 citations). Figure 4 depicts the citation analysis network map of the institutions.

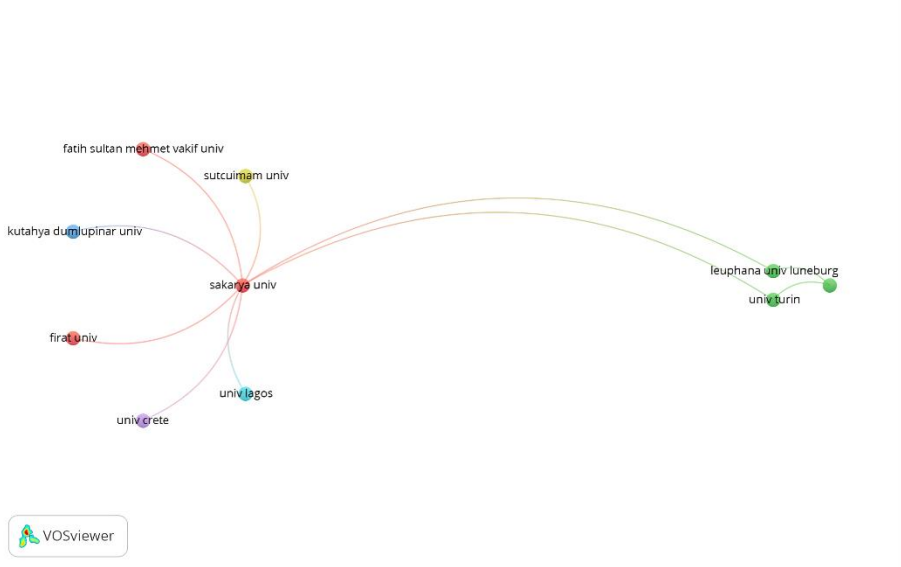

Figure 4: Citation Analysis of Institutions

4.1.5. Keyword Analysis (Co-occurrence of All Keywords)

The most frequently used keywords in publications on leadership 4.0 were leadership with five repetitions, Industry 4.0 with four repetitions and digital leadership with two repetitions. Figure 5 shows the keyword analysis network map.

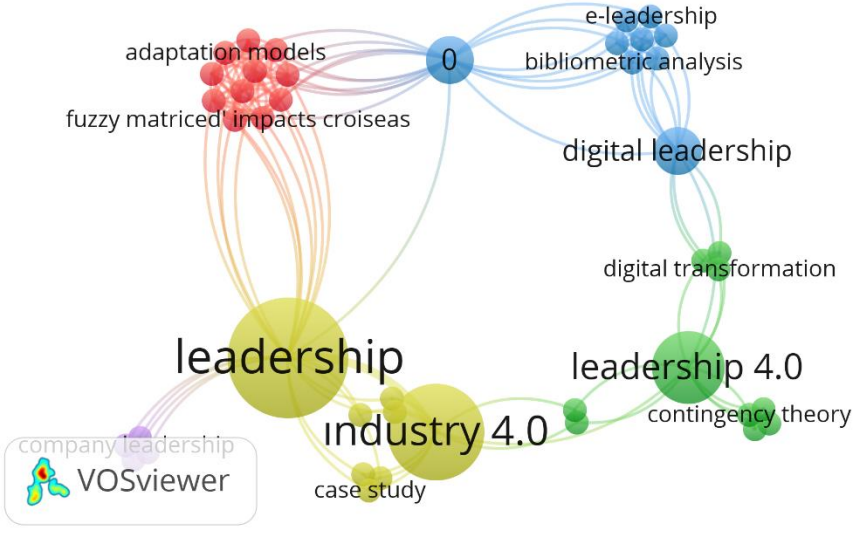

Figure 5: Keyword Analysis

4.1.6. Bibliographic Coupling of Documents

The publications with the highest number of bibliographic matches were Oberer (2018) with 82 citations, Eberl (2021) with 26 citations and Helming (2019) with 16 citations. The works with the highest total link strength were Eberl (2021), Karaköse (2022) and Avwokeni (2024). Figure 6 shows the bibliographic match analysis network map of the texts.

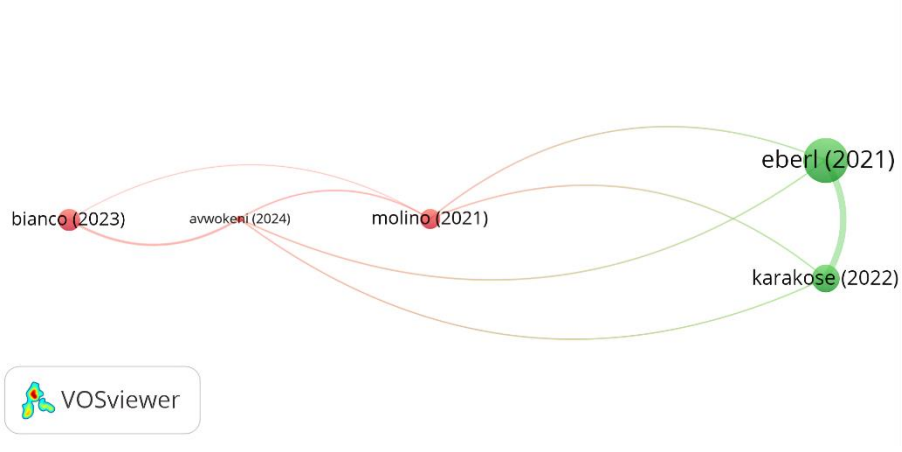

Figure 6: Bibliographic Match Analysis of Texts

4.1.7. Co-citation of Co-authors Analysis

According to the analysis conducted over 583 units by selecting the minimum number of citations as one, the authors with the highest number of co-citations are Birgit Oberer (six) and Turgut Karaköse (seven). Figure 7 shows the network map of the authors' co-citation analysis.

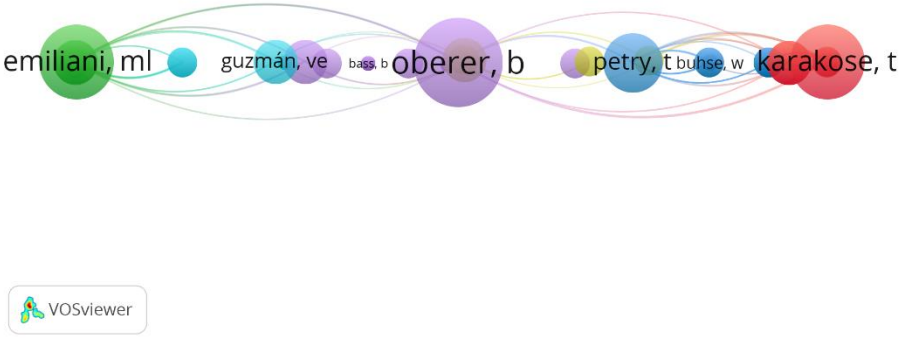

Figure 7: Authors' Joint Citation Analysis

4.2. Keywords of Leadership 4.0 Studies in Organizational Behavior

Table 1 below shows the keyword analysis used in the studies in the WOS database on leadership 4.0 in terms of organizational behavior.

Table 1: Keywords of Leadership 4.0 Studies in terms of Organizational Behavior

Keywords of Leadership 4.0 Studies in terms of Organizational Behavior	
Keywords	**Frequency of Use**
Leadership	5
Digital Leadership	2
Change Management	1
Company Leadership	1
Corporate Leadership	1
E-Leadership	1
Employee Leadership	1
Leadership Skills	1
Learning Organization	1
Process Safety Leadership	1
Risk Communication	1
Self-Assessment	1
Technology Acceptance	1
Technology Leadership	1
Virtual Leadership	1
Work Engagement	1

The analysis revealed that the concept of leadership 4.0 was addressed in conjunction with a range of related concepts, including leadership, digital leadership, virtual leadership, leadership skills, change management, and passion for work. Figure 8 below shows the links of the keywords used in the studies in the WOS database on leadership 4.0 in terms of organizational behavior.

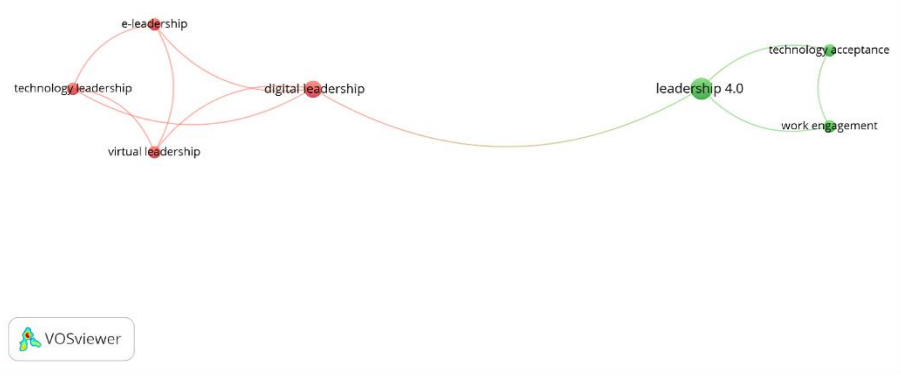

Figure 8: Keyword Analysis of Leadership 4.0 Studies in Organizational Behavior

Figure 8 shows that leadership 4.0 is related to the concepts of digital leadership, technology acceptance, work engagement, e-leadership, virtual leadership and technology leadership.

5. CONCLUSION AND RECOMMENDATIONS

The advent of Industry 4.0 technologies, including artificial intelligence, the Internet of Things, and big data, has set in motion a global social and technological transformation. This enables the integration and management of information at the component level. The latest status of production is conveyed to customers in a timely and accurate manner. The generation of data commences at the outset of the production process. The data is collected, analyzed, and improved to ensure accurate output and actual product performance. It develops and optimizes new technologies and processes (Javaid et al., 2022: 203).

Organizations that utilize Industry 4.0 technologies can adapt to the Industry 4.0 revolution, thereby gaining a competitive advantage. The implementation of Industry 4.0 technologies enables the conservation of resources utilized in the production process, while simultaneously facilitating the manufacture of products with enhanced quality and distinctive characteristics. It is therefore evident that the utilization of Industry 4.0 technologies within organizational frameworks is of significant importance. As it is the employees who utilize Industry 4.0 technologies within the organizational context, it is imperative that their knowledge, skills and abilities align with the requisite level of proficiency to effectively employ these technologies. Given their capacity to influence and direct the equipment of employees, leaders bear the responsibility of guiding their teams towards the utilization of these technologies.

The leadership 4.0 approach places a premium on the deployment of Industry 4.0 technologies with a view to generating fresh opportunities in both the market and the local economy. Leadership 4.0 provides organizations with the tools to overcome a variety of challenges and enhance their industrial management systems. Leadership

4.0 provides organizations with the capacity to respond expeditiously and adaptively to shifts in market dynamics, evolving consumer expectations, and technological innovations. This enhances a company's agility and competitiveness. Furthermore, it allows the organization to maintain its competitive advantage over the long term. The leadership 4.0 approach places an emphasis on empowerment, growth, and the involvement of employees in decision-making processes. Consequently, levels of employee satisfaction and organizational commitment are enhanced (Haleem, Javaid and Singh, 2024: 2).

The results of the literature review indicate that the utilization of Industry 4.0 technologies is a prerequisite for organizations seeking to gain a sustainable competitive advantage. Moreover, the concept of leadership 4.0 has been observed to facilitate the utilization of Industry 4.0 technologies by organizations. The successful implementation of Industry 4.0 technologies within an organizational context is contingent upon leaders' ability to influence and direct employees in alignment with their objectives, given that it is the employees who will utilize these technologies.

A network map was constructed by identifying at least one publication and at least one citation criterion in order to ascertain the most connected and collaborative authors according to the co-authorship analysis of the authors of the studies on the concept of leadership 4.0 in all fields within the WOS database. In the cluster, one of the authors was not connected to any other authors, four had one connection, nine had two connections, four had three connections, five had four connections, six had five connections, and seven had six connections. The authors who were most frequently cited were Alptekin Erkollar (82 citations), Birgit Oberer (82 citations), Paul Drews (26 citations), and Julia K. Eberl (26 citations). The countries with the highest number of citations were Turkey (96), Germany (55), and Greece (15). With regard to the number of publications, the order is as follows: Germany (three publications) and Turkey (two publications). The institutions associated with the highest number of citations were Sakarya University (82 citations), Leuphana University of Lüneburg (26 citations), and Karlsruhe Institute of Technology (16 citations). The most frequently utilized keywords in publications pertaining to leadership 4.0 were "leadership" (five repetitions), "industry 4.0" (four repetitions), and "digital leadership" (two repetitions). The publications with the highest number of bibliographic matches were Oberer (2018) with 82 citations, Eberl (2021) with 26 citations and Helming (2019) with 16 citations. The works with the highest total link strength were Eberl (2021), Karaköse (2022) and Avwokeni (2024). According to the analysis conducted over 583 units by selecting the minimum number of citations as one, the authors with the highest number of co-citations were Birgit Oberer (six) and Turgut Karaköse (seven).

In order to provide researchers with a conceptual framework for future studies by addressing the bibliometric aspects of the studies on leadership 4.0 related to organizational behavior in the WOS database, the keywords of the studies on leadership 4.0 related to organizational behavior were analyzed using the VOSviewer program. It was found that the term leadership 4.0 was used five times with leadership

and twice with digital leadership. Change management, business leadership, corporate leadership, e-leadership, employee leadership, leadership skills, learning organization, process safety leadership, risk communication, self-assessment, technology acceptance, technology leadership, virtual leadership, and work engagement were used together once. Although leadership 4.0 is an important issue for the country, society, the organization and employees, the fact that there are very few studies on leadership 4.0 in the organizational behavior field in the WOS database is an important finding to draw attention to the fact that the topic has not been sufficiently studied.

However, in order to better understand the concept of leadership 4.0 in terms of organizational behavior, researchers are recommended to conduct studies on its relationship with concepts such as job satisfaction, perceived employability, intention to stay at work, employee performance, resistance to change, innovative work behavior, individual innovation, organizational commitment, organizational citizenship. It may be beneficial for leaders to obtain knowledge and skills aligned with the Industry 4.0 revolution, and to encourage their employees to adopt these practices. Organizations are advised to use Industry 4.0 technologies to ensure efficiency and effectiveness in the design, production and sales stages of products.

This study has a number of limitations. The important limitations of this study include the fact that only the WOS database was taken into account in this study and that databases such as TUBITAK Ulakbim in Turkey and Scopus and Pubmed in the international arena were not included in the analysis.

ENDÜSTRİ 4.0'IN YANSIMASI OLAN LİDERLİK 4.0'A ÖRGÜTSEL DAVRANIŞ AÇISINDAN BİBLİYOMETRİK BİR İNCELEME

1. GİRİŞ

Günümüzde örgütler rekabetçi kalabilmek için teknolojilerini, bilgilerini ve işgücü becerilerini Endüstri 4.0 anlayışına göre değiştirmeye çalışmaktadırlar (Akçay Kasapoğlu, 2018: 300). Endüstri 4.0 devrimi ürünlerin tasarımında, üretiminde ve satılmasında hızlı dijital dönüşümü ifade etmektedir (Oberer ve Erkollar, 2018). Endüstri 4.0 devrimi son on yılda küresel olarak benimsenen bir kavram olmuştur. Birçok ülke Endüstri 4.0 devrimi için başlattıkları stratejik girişimleri geliştirmek için önemli çaba harcamışlardır (Xu et al., 2021: 530). Endüstri 4.0 devrimi ülke ve örgütler için ekonomik, sosyal ve çevresel gelişim sağlamaktadır. Endüstri 4.0 devriminin teknolojik unsurları (yapay zeka, nesnelerin interneti, büyük veri, bulut bilişim gibi) de gelecekte yapılacak inovasyon ve iş büyümeleri için kritik perspektifler sunmaktadır. Endüstri 4.0 teknolojileri kullanıldığında ürünler daha verimli üretilebilmekte, kaynak tüketimi azalabilmekte ve çevrenin sürdürülebilirliği sağlanabilmektedir. Endüstri 4.0 teknolojileri üretim hatlarının, iş süreçlerinin,

ekipmanların zaman dilimi ve ağdan bağımsız bir şekilde işbirliği yapmasını sağlamaktadır (Javaid et al, 2022: 203).

Endüstri 4.0 çağı en devrimci teknolojik ilerlemelere sahne olmuştur. Bu durum, bireylerin kariyerlerini ilerletmeleri için yeni alanlar yaratırken, üreticiler ve girişimciler için de yeni fırsatlar yaratmıştır. Bu içgörüler, operasyonel yeterliliği artırmak ve maliyetleri düşürmek için çok önemlidir (Haleem, Javaid and Singh 2024: 1). Günümüzde teknolojik gelişme ve inovasyon çoğu örgütte önemli bir rol oynamaktadır. Bu, herhangi bir örgütün özellikle rekabet gücündeki artışa yansımaktadır. Endüstri 4.0 devrimi endüstri sektörünün ötesine geçen çeşitli alanlarda olası köklü değişikliklere yol açmaktadır. Bununla birlikte inovasyon kültürünün başarılı bir şekilde teşvik edilmesi için liderlik şarttır. Bu nedenle liderler ve liderlik tarzı Endüstri 4.0 devrimine geçişte kilit bir rol oynamaktadır (Puhovichova and Jankelová, 2021: 1).

Endüstri 4.0 teknolojilerinin günlük hayatımıza yüksek hız ve sorunsuz bir şekilde entegre edilip uygulandığı bir gerçek dijital dünya çağında nefes almakta ve yaşamakta olmamız nedeniyle bu teknolojiler önem arz etmektedir. Endüstri 4.0 teknolojilerinin sürdürülebilirlik için olumlu fırsatlar yaratacağı beklentisi kavramın önemini artırmaktadır. Bu nedenle akademinin Endüstri 4.0 devrimini dikkate alması gerekmektedir (Ghobakhloo, 2020: 2; Venkatesh: 2020: 2709).

Dijital yıkım neredeyse her sektörde görülürken ne yazık ki liderlik stratejileri bu hıza ayak uyduramamaktadır. Bazı liderler Endüstri 4.0 teknolojileriyle başarılı bir şekilde başa çıkmak için iyi hazırlanmış olsa da, birçok lider daha az hazırlıklı olmaya devam etmektedir (Venkatesh, 2020: 2709).

Dijital teknolojiler iş dünyasını etkilemekle kalmamaktadır. Örgütlerin yönetilme ve uygulanan liderlik tarzlarını da şekillendirmektedir. Endüstri 4.0 devriminin getirdiği değişimler, Endüstri 4.0 yaklaşımına uygun liderlik kültürünün geliştirilmesini gerektirmektedir. Endüstri 4.0 devrimiyle teknolojinin yükselişi ve üretim süreçlerinin değişimi liderlik tarzının dönüşmesini gerektirmektedir (Bianco et al., 2023).

Liderlik 4.0, Endüstri 4.0 çağında liderlik anlamına gelmektedir. Liderlik 4.0 örgüt yönetiminde, kârı, verimliliği, müşteri memnuniyetini artıran çözümler bulmak ve uygulanmasını ifade etmektedir. Liderlik 4.0 örgütü inovasyon eğrisinin önünde tutmak için adım adım ilerleyen bir süreç olarak kullanılabilmektedir (Oberer and Erkollar, 2018).

Liderlik 4.0 yeni teknolojilerin örgütte uygulanmasını yönetme becerisinden daha fazlasını gerektirmektedir. Liderler yeni teknolojileri örgüte entegre ederken bu sürece çalışanları da dahil etme becerisine sahip olmalıdırlar. Dolayısıyla yeni teknolojilerin örgütte uygulanması sürecinde bu teknolojilerin kabulünü ve doğru kullanımını da sağlamaları gerekmektedir (Molino, Cortese and Ghislieri, 2021: 4).

Liderler yapay zekanın faaliyet gösterdiği sektörü ve örgütü nasıl etkileyeceğini anlamalıdırlar. Liderlik 4.0 değişen koşullara uyum sağlayan açık ve yenilikçi bir kültürü teşvik etmektedir. Etkili dijital liderler yönetici, insan, bilgisayar ve süreç arasındaki sürekli değişen etkileşimi yönetmektedirler. Ayrıca sürekli bir şekilde bilgi paylaşımı, iş birliği ve inovasyonu teşvik etmektedirler (Haleem, Javaid and Singh, 2024).

Sonuç olarak Endüstri 4.0 devriminin örgütlerin rekabetçi bir avantaj elde edebilmelerinde belirleyici olduğu ortaya çıkmaktadır. Endüstri 4.0 teknolojilerinin örgütlerin kullanılmasının önem arz ettiği ve bunun liderler aracılığıyla mümkün olduğu söylenebilmektedir. Çünkü liderler bu teknolojilerin aktarılmasında aracılık rolü oynamaktadırlar. Bu kapsamda liderlerin Endüstri 4.0 devrimine uygun bir şekilde liderlik tarzına sahip olmasını ifade eden liderlik 4.0 kavramı söz konusu olmaktadır. Diğer taraftan Endüstri 4.0 teknolojilerini örgütte kullananlar çalışanlar olduklarından çalışanların bilgi, beceri ve yeteneklerinin kullanabilecek düzeyde olması gerekmektedir. Liderler çalışanların donanımlarını etkileyip yönlendirebilme gücüne sahip olduklarından çalışanları bu teknolojileri kullanmaya yönlendirmeleri gerekmektedir. Bu çalışmada Web of Science veri tabanında örgütsel davranış açısından liderlik 4.0 ile ilgili yapılmış çalışmaların bibliyometrik açıdan ele alınarak daha sonra yapılacak çalışmalar için araştırmacılara kavramsal bir çerçevenin çizilmesi amaçlanmıştır. Daha önce literatürde bu konuda yapılan bir çalışmaya rastlanmaması mevcut çalışmayı özgün kılmaktadır. Yapılan analizler neticesinde liderlik 4.0 konusunda uygulayıcı ve araştırmacılar için öneriler geliştirilmiştir.

2. VERİ VE ANALİZ

Bu çalışmada WOS veri tabanı kullanılmıştır. 28.06.2024 tarihinde "leadership 4.0" anahtar kavramıyla tüm alanlar seçilerek araştırma yapılmış ve 13 çalışmaya ulaşılmıştır. Bu yolla elde edilen verilere VOSviewer programı aracılığıyla analiz edilmiştir.

3. SONUÇ

Yapılan literatür araştırması sonucunda Endüstri 4.0 teknolojilerini kullanmanın sürdürülebilir rekabetçi bir avantaj elde etmek isteyen örgütler için bir zorunluluk olduğu anlaşılmıştır. Ayrıca örgütlerin Endüstri 4.0 teknolojilerini kullanabilmesinde liderlik 4.0 kavramının bir köprü görevi gördüğü görülmüştür. Endüstri 4.0 teknolojilerinin örgütte başarılı bir şekilde kullanılabilmesi de bu teknolojileri kullanacak olanların çalışanlar olması nedeniyle liderlerin çalışanları hedefleri doğrultusunda etkileyip yönlendirmesi ile mümkün olabilmektedir. Bu çalışmada örgütsel davranış açısından WOS veri tabanındaki liderlik 4.0 ile ilgili yapılmış çalışmaların bibliyometrik olarak ele alınıp daha sonra yapılacak çalışmalar için araştırmacılara kavramsal bir çerçevenin çizilmesi amacı doğrultusunda liderlik 4.0 çalışmaları VOSviewer programı aracılığıyla analiz yapılmıştır. Yapılan analiz sonucunda liderlik 4.0 kavramının liderlik, dijital liderlik, sanal liderlik, liderlik becerileri, değişim yönetimi, işe tutkunluk gibi kavramlarla ele alındığı görülmüştür.

Ancak liderlik 4.0 kavramının örgütsel davranış açısından daha net bir şekilde anlaşılabilmesi için araştırmacılara iş tatmini, algılanan istihdam edilebilirlik, işte kalma niyeti, işgören performansı, yenilikçi iş davranışları, bireysel yenilikçilik, örgütsel bağlılık, örgütsel vatandaşlık, değişime direnç gibi kavramlarla ilişkisini ele alan çalışmaları yapmaları önerilmektedir. Liderlerin Endüstri 4.0 devrimine uygun bilgi ve beceri kazanmaları ve bu doğrultuda çalışanlarını da motive etmeleri yararlı olabilecektir. Örgütlere ise ürünlerin tasarım, üretim ve satış aşamalarında verimlilik ve etkililik sağlayabilmeleri için Endüstri 4.0 teknolojilerini kullanmaları tavsiye edilmektedir.

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