International Technology and Education Journal
Vol. 8 No. 2; December 2024
ISSN: 2602-2885
URL: http://itejournal.com/

Özçınar, H. (2024). Evolution of Organizational Learning Research over 35 Years: A Comprehensive Review using Dynamic Topic Modeling and Network Analysis. International technology and education journal, 8(2), 01-13.

Evolution of Organizational Learning Research over 35 Years: A Comprehensive Review using Dynamic Topic Modeling and Network Analysis

Hüseyin Özçınar, hozcinar@pau.edu.tr, Pamukkale University, Turkey, https://orcid.org/0000-0001-8715-2653

SUMMARY

This study aims to examine the intellectual structure and development of the organizational learning field between 1990 and 2024. An analysis was performed on the titles and abstracts of 18,735 articles obtained from the Scopus database using dynamic topic modeling (DTM) and network analysis methods. DTM explores the organization and chronological development of topics, while network analysis examines the relationships between topics and their changes over time. The findings of the study show that knowledge management, innovation and strategic learning are prominent in the organizational learning literature. In addition, it was determined that since 2005, learning and technology issues have gained importance and this field has become a central focus of interest. The findings of the study help organizations prioritize critical areas in today's organizational learning approaches, facilitating faster adaptation and innovation. However, as the study is based solely on the Scopus database, it may have geographical and linguistic limitations. The findings need to be validated in different datasets.

Keywords: Organizational learning, dynamic topic modeling, artificial intelligence, sustainability.

INTRODUCTION

Social dynamics are evolving at an unprecedented rate as a result of rapid technological progress. Innovations in the production, acquisition, and use of knowledge have made organizational learning even more crucial for companies. In the broadest sense, organizational learning, which includes the processes of acquiring, processing, and integrating knowledge, improves organizations' competitiveness in the information society by increasing their ability to adapt to changing conditions, thereby positively affecting corporate performance (Argote & Miron-Spektor, 2011). Research has demonstrated that firms that can effectively plan and implement organizational learning outperform their competitors in terms of innovation skills (Alegre & Chiva, 8), operational agility (Camps et al., 2016), and financial performance. According to research, firms that excel at organizational learning perform better in digital transformation (Dörner & Rundel, 2021) and sustainability programs (Li et al., 2022). In this scenario, organizations that prioritize organizational learning will not only gain a competitive edge, but will also be able to advance in terms of rapid adaptability, resilience, and sustainability.

The strategic relevance of organizational learning, its complexity, and the changes brought about by technology both in the field of learning and in the corporate world have resulted in the field being a rapidly evolving and diverse one. Cyert and March (1963), pioneers in the field, proposed the notion of organizational learning in relation to behavioral decision-making processes. Over time, a multidisciplinary theoretical framework has emerged in the field of organizational learning, attracting the interest of scholars from a broad range of disciplines. During this period, several significant researchers contributed to the field from various angles. For example, Argyris and Schön (1978) studied organizational learning using single and double loop learning models, whereas Levitt and March (1988) investigated how companies apply their experiences from a historical viewpoint. Nonaka (1994) modeled knowledge creation processes, while Huber (1991) detailed the flow of information inside businesses. The field was founded on this conceptual framework and has since been refined and expanded by academics such as Easterby-Smith (1997), Crossan et al. (2011), Argote and Miron-Spektor, (2011), and Levitt and March (2017).

The complex and interdisciplinary nature of the field (Popova-Nowak & Cseh, 2015) and the difficulties in the integration of individual, group and organizational studies (Crossan et al., 2011) cause the field to be fragmented. In addition to this fragmented structure, it is seen that the field has also experienced a rapid transformation in the digital transformation process that has been experienced very rapidly in recent years. Big data, Internet of Things (IoT) and artificial intelligence-based systems have led to significant changes in the processes of acquiring, processing and using information in organizations (Abubakar et al., 2019; Dwivedi et al., 2021). For example, artificial intelligence applications can generate knowledge independently of past experiences through reinforcement learning (Shrestha et al., 2019); learning cycles are accelerated by real-time analysis of big data from employees, customers and suppliers; and augmented reality (AR) and virtual reality (VR) systems can enrich employees' cognitive learning processes (Li et al., 2022).
Apart from technological developments, events and phenomena that cause social and societal changes such as the

Checked for artificial intelligence content Checked with a plagiarism detection software

COVID-19 pandemic can be considered among the reasons for the rapid evolution of the field. During the pandemic, organizations have experienced processes that they have never experienced in history and have had to acquire new skills in areas such as remote working, digital collaboration, and rapid decision-making (Seetharaman, 2020). While this process has enabled organizations to test and improve their crisis management and resilience capacities, it has also forced them to approach organizational learning from a new perspective (Carnevale & Hatak, 2020).

In conclusion, technological and social advances have rapidly transformed the already diverse and fragmented subject of organizational learning. This has made it harder for scholars and practitioners to understand the field holistically, identify trends, and develop strategies for the future. Mapping the structure and evolution of the field with big data sets that reflect all subfields is expected to benefit the field. Review studies on organizational learning have examined different dimensions of learning processes (Argote & Miron-Spektor, 2011), the effects of learning on organizational performance (Jiménez-Jiménez & Sanz-Valle, 2011), learning factors (Schilling & Kluge, 2009), technological developments on learning dynamics (Robey et al., 2000), and learning strategies under environmental uncertainty (March, 1991). Nevertheless, the existing studies in the literature are obsolete, constrained by the time frames and analytical techniques employed, and fail to adequately anticipate present patterns and trends.

This study aims to demonstrate the structure and evolution of the organizational learning (OL) literature throughout time. To this goal, all papers published between 1990 and 2024 and indexed in the Scopus database were reviewed. Initially, descriptive statistics were calculated using the obtained dataset. The dataset was then analyzed using Dynamic Topic Modeling (DTM). Finally, the DTM data were evaluated using content and social network analysis to provide a more in-depth understanding of the field. This method expands on standard literature reviews, allowing for a more objective and complete discovery of latent themes and patterns in organizational learning. As a result, useful conclusions can be drawn regarding the literature's conceptual growth, including breaking points, emerging themes, and future prospects. This study seeks to provide a unique contribution to the literature by examining how the field of organizational learning has evolved from the past to the present and identifying future research trends.

METHOD

Data Collection and Pre-processing

In this study, the Scopus database was chosen for a broad and thorough evaluation of organizational learning literature. Scopus is one of the most comprehensive and dependable academic databases, containing academic journals, congress proceedings, and books from a variety of subjects (Omotehinwa, 2022). The Scopus database, which is utilized in many comparable studies to access academic literature in the topic of organizational learning, is critical to the research's validity and dependability (Burnham 2006).
To determine the search phrases, review papers in the relevant literature were first scanned, and the search terms chosen in these studies were examined. The ultimate objective of this process was to identify keywords such as "organizational learning," "learning organization," and "learning organization" in order to conduct a comprehensive search of pertinent studies. Furthermore, to represent the breadth and depth of the field, publications unique to the field were also incorporated into the search. These journals include Development and Learning in Organizations, Management Learning, Journal of Workplace Learning, and The Learning Organization. This approach is crucial in that it enables access to significant publications in the literature that are often disregarded due to the absence of the selected keywords in the title, abstract, or keyword sections (Tranfield et al., 2003; Pittaway et al., 2004). As a result of implementing this method, the May 15, 2024 search yielded 20,755 publications. These publications included research articles, review articles, and congress proceedings.

Out of the 20,551 papers acquired, those without any of the title, abstract, or year of publication information were eliminated from the dataset, therefore reducing the total count to 18,735 publications. All of the publications in this dataset had their title and abstract texts combined, special characters and punctuation marks eliminated, and their texts lowered case. Stop words were eliminated from the works in the next phase. In terms of content, stopwords have no significant meaning; so, in topic modeling research, as in many natural language processing tasks, it is usual to eliminate stopwords from the dataset.

Furthermore applied on the dataset's words was stemming to get more consistent findings. This approach seeks to simplify words derived from the same root to a single stem form. For instance, the words "learning," "learned," and "learns" were shortened to just "learn." This method lets several significant phrases be combined under a single idea, therefore enabling more consistent study of texts in topic modeling procedures (Blei, Ng, & Jordan, 2003; Manning, Raghavan, & Schütze, 2008). These terms were handled as a single unit in order to maintain the integrity of multi-word terminology particular to the organizational learning field. This method was selected to guarantee precise portrayal of domain-specific ideas and preservation of their meaning. Treating these kinds of terms as a single conceptual unit makes the model simpler, which leads to more understandable and consistent results (Griffiths & Steyvers, 2004).

Data Analysis

The themes in the organizational learning domain and their evolution over time were analyzed using Dynamic Topic Modeling (DTM). According to Blei and Lafferty (2006), DTM builds on LDA and can show how themes change over time. This approach seeks to better grasp the dynamic structure and evolution of the field as well as track the changes of topics in the literature on organizational learning over time.

Research and review papers published in journals indexed by Scopus and proceedings booklets from congresses held between 1990 and 2024 make up the data set utilized for the research. The 35-year period under investigation was divided into six periods: 1990-1999, 2000-2004, 2005-2009, 2010-2014, 2015-2019, and 2020-2024. This was required due to the difficulties associated with interpreting the year-by-year examination results, the insufficient number of publications for the DTM method to produce accurate results for each year, and the disproportionate number of publications in recent years, particularly after 1990s.

The accuracy and interpretability of the model depend much on the best number of subjects in topic modeling analysis. The model fit for several numbers of themes was assessed in this work using the coherence score measure (see Figure 1). This statistic gauges the coherence of the acquired subjects; larger values show that the model generates more significant and coherent themes (Mimno et al., 2011). It was found that 14 topics was the ideal amount after examination for different numbers of topics. By increasing the explanatory power of the model, this value guarantees that the topics are distinct and discrete.

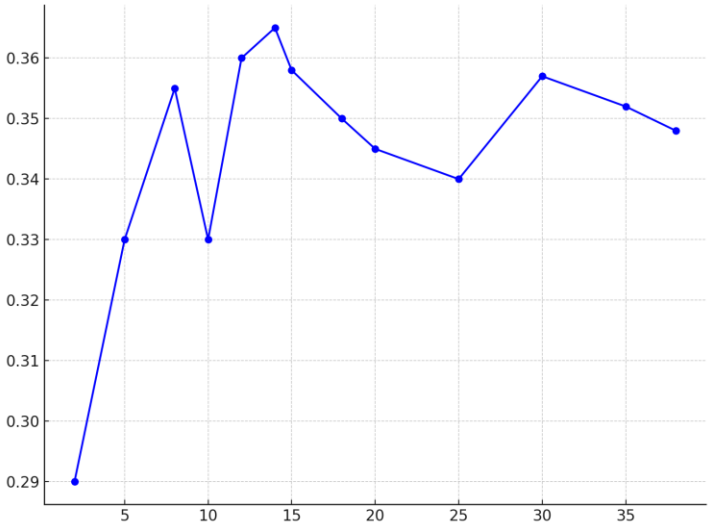

Figure 1: Coherence Scores Across Different Topic Numbers for Dynamic Topic Modeling

The DTM analysis was implemented using the Gensim library. The Gensim library was selected due to its efficiency in processing large-scale textual data and its extensive use in numerous academic assignments (Řehůřek & Sojka, 2010). After analyzing the DTM analysis results, the relationships between topics were examined by evaluating the correlation between topics in order to acquire extensive information about the field's structure in terms of centrality measures (Wasserman & Faust, 1994). The topic networks illustrated the significance of each topic in the field, its relationships with other topics, and the evolution of these relationships over time.

The evolution of the organizational learning field was comprehensively investigated in this study through the use of Dynamic Topic Modeling (DTM) and a variety of descriptive analyses. These analysis displayed the distribution of publications by nation, funding organization, and year, illustrating the field's global spread as well as the institutions that support research in this area. Graphs showing publishing trends over time also help to clarify the expansion and changes in emphasis within the field of organizational learning. The investigation also pinpointed the main contributors to the discipline, analyzing the extent to which their contributions have impacted its advancement.

Labeling the subjects found by DTM helped to capture the core of every theme and its development across time. Two researchers separately assessed the top 10 papers most strongly linked to each topic and the keywords most fitting for each period throughout this process. Their labeling differences were reviewed, and finally the labels agreed upon. This all-encompassing method gave a clear view of the evolution of the organizational learning area by means of in-depth knowledge of thematic changes and main trends.

FINDINGS

The first step was to analyze studies in the field of organizational learning by country, publication year, researcher, and funding organizations, as shown in Figure 2. In terms of geographic distribution, the United States and the

United Kingdom were the primary contributors to the organizational learning literature. These two countries account for a large proportion of total publications, while scholars from Australia, China, Canada, and Germany have also made substantial contributions. This distribution underscores the substantial representation of organizational learning research in the Anglo-Saxon academic community. Nevertheless, it is crucial to acknowledge the possibility of certain biases in the data, as the Scopus database predominantly encompasses English-language journals.

Since 1990, there has been a consistent rise in interest, as evidenced by the distribution of publications over time (see Figure 2). The increasing influence of digital transformation and artificial intelligence technologies exacerbated this increase in the early 2000s. This upward trend continued to accelerate after 2010. It is crucial to acknowledge that the apparent decline in 2024, as depicted in Figure 2, is the result of the data being retrieved as of May 15, 2024.

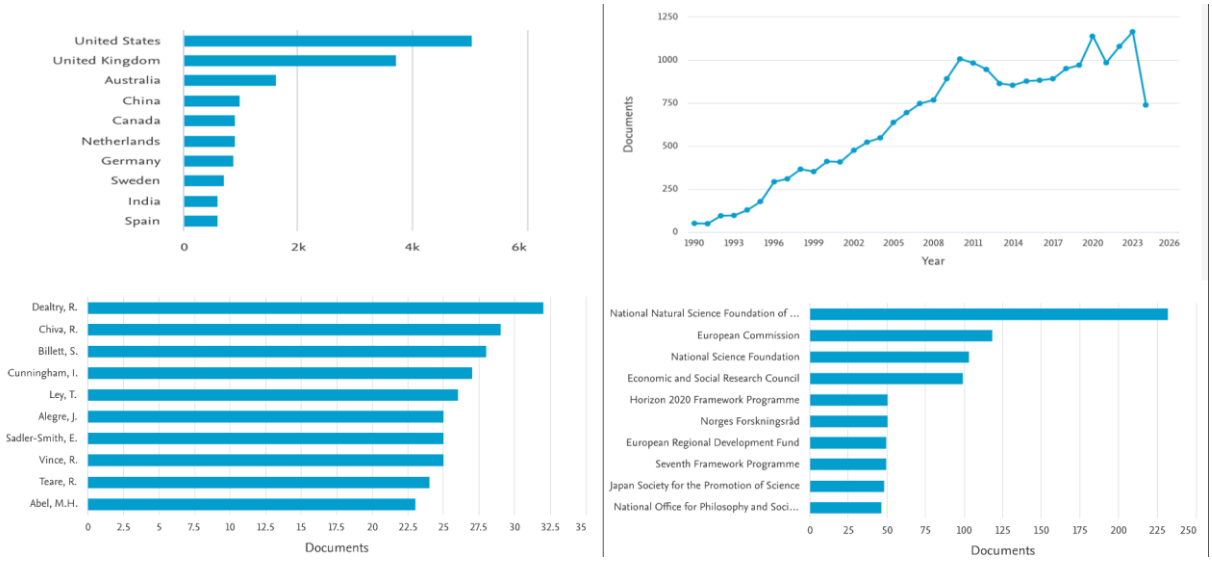

Figure 2. Distribution of Organizational Learning Publications by Country, Year, Author, and Funding Sponsor

When looking at organizational learning studies by author, those who have made substantial contributions and affected its direction also have the most publications (see Figure 2). Among the most prolific researchers, Richard Dealtry bridges academics and business with his management education and development work. Raquel Chiva's studies on organizational learning and innovation—with an eye toward team dynamics and creativity especially—have attracted notice. While Isobel Cunningham is famous for her works on organizational change and adaptation, Stephen Billett is acknowledged for his theoretical contributions to vocational education and workplace learning. Thomas Ley, meantime, is notable for his work on learning analytics and learning management systems.

The National Natural Science Foundation of China is the most prominent funding body in the field of organizational learning when the institutions that fund research are taken into account. China does not rank #1 in terms of total publications, although it is noteworthy that the National Natural Science Foundation of China sponsors most of the research. The European Commission comes second as well, suggesting deliberate support for organizational learning research.

Dynamic Topic Modeling Results

Coherence scores for various topic counts were evaluated, and it was determined that 14 topics could adequately represent the field from 1990 to 2024 as shown in Figure 1. Under dynamic topic modeling, publications from each period are classified into topics according to their relevance during that period. Looking at the overall count of papers allocated to every topic, "Topic 9" has 2,575 documents whereas "Topic 4" has 984 documents. The other subjects have respective weights of 1,922 (Topic 3), 1,689 (Topic 0), 1,689 (Topic 12), and 1,689 (Topic 0).

The evolution of these topics and their shifting research focus over time is noteworthy. Publications on "Learning Theories" (T9) increased steadily from the early 1990s to 2010-2014, peaking before declining, as shown in Figure 3. This implies that fundamental theories developed and evolved, leading to a shift towards more pragmatic and application-oriented research. On the other hand, the issue of "Technology and Learning" (T4), which was not given much importance in the 1990s, experienced a considerable increase in attention after 2005. It has now become one of the most important topics in organizational learning during the decade of 2020-2024. Initial investigations in this field concentrated on e-learning systems and learning management platforms,

however subsequent studies turned their focus to mobile learning technologies and AI-driven tailored learning environments. This phenomenon demonstrates the increasing significance of using digital technologies into educational procedures.

The topics of "Human Resources" (T10) and "Training and Development" (T6) had a comparable path. Beginning in the mid-2000s, their importance grew, eventually peaking over the era of 2020-2024. The primary emphasis of Human Resources has shifted from fundamental HR procedures to the management of talent, fostering employee involvement, and ultimately, strategic HR. Similarly, the emphasis of Training and Development shifted from solely providing instruction to employees to include the development of leadership skills, fostering talent growth, and ultimately incorporating digital learning platforms. Human capital and lifelong learning are becoming more important to enterprises, as seen by this trend.

Table 1. Evolution of Topic Focus Areas in Organizational Learning Research from 1990 to 2024

Topic Name	1990-1999	2000-2004	2005-2009	2010-2014	2015-2019	2020-2024
Knowledge Management (T0)	Knowledge sharing, information systems	Knowledge transfer, knowledge creation	Knowledge repositories	Knowledge retention	Knowledge analytics	Knowledge automation
Innovation (T1)	Product innovation	Team creativity	Innovation-supportive structures	Creativity management	Innovation ecosystems	Disruptive innovation applications
Collaborative Learning (T2)	Team-based learning	Group learning processes	Virtual collaboration	Cross-functional teams	Digital collaboration tools	Global collaboration networks
Leadership and Culture (T3)	Impact of leadership on culture	Leadership styles	Cultural transformation	Inclusive leadership	Leadership development programs	Adaptive leadership
Technology and Learning (T4)	Early e-learning systems	Adoption of learning management systems	Blended learning	Mobile learning technologies	Artificial intelligence in learning	Personalized learning environments
Strategic Learning (T5)	Alignment of learning with business strategy	Strategic alignment	Strategic initiatives	Long-term strategic learning	Strategic foresight	Strategic agility
Training and Development (T6)	Employee training	Development initiatives	Leadership development	Talent development	Continuous learning	Digital learning platforms
Performance Improvement (T7)	Efficiency enhancement	Performance measurement	Efficiency improvement	Performance management systems	Data-driven performance	Performance optimization
Change and Adaptation (T8)	Change management	Organizational adaptation	Change initiatives	Organizational resilience	Agile transformation	Adaptive capacity
Learning Theories (T9)	Fundamental theories	Conceptual frameworks	Applied models	Modern learning paradigms	Theoretical developments	Integrated models
Human Resources (T10)	Human resources practices	Talent management	Employee engagement	Workforce development	HR analytics	Strategic human resources
Sustainability (T11)	Environmental learning	CSR initiatives	Sustainable practices	Corporate sustainability	Sustainability integration	Sustainable innovation
Organizational Learning Mechanisms (T12)	Learning routines	Learning processes	Learning mechanisms	Organizational tools	Learning frameworks	Process improvement
Knowledge Integration (T13)	Information systems	Decision support systems	Knowledge synthesis	Integrated systems	Knowledge networks	AI-assisted integration

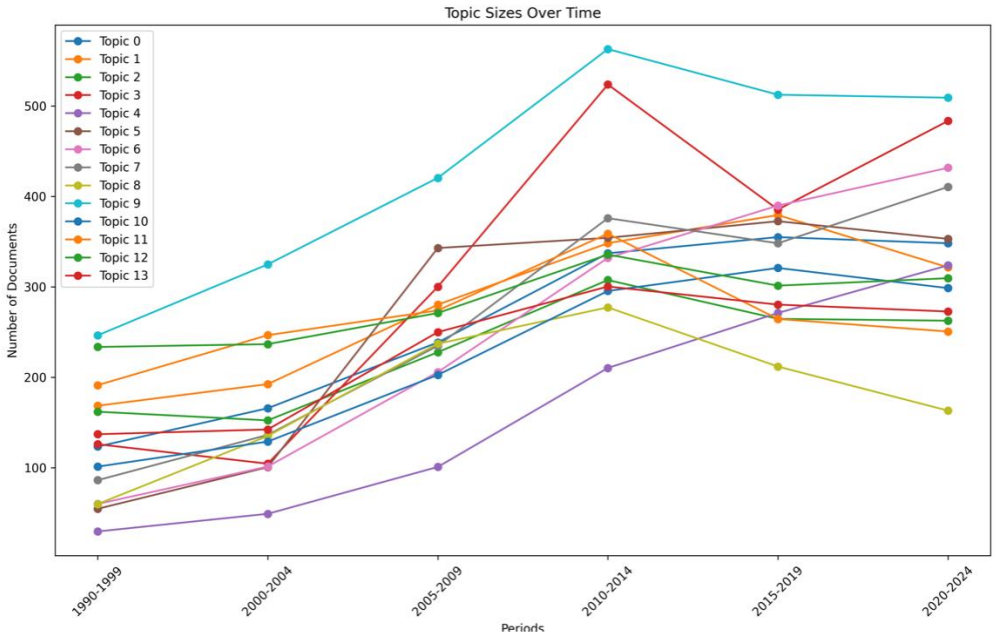

Figure 3. Temporal Evolution of Topic Sizes in Organizational Learning Literature (1990-2024)

Since the early 2000s, "Knowledge Integration" (T13) publications have increased rapidly, peaking between 2010 and 2014. The focus of research in this field has evolved from fundamental information systems to decision support systems, integrated platforms, and ultimately AI-powered integration. This shows enterprises' rising focus on knowledge management and integration. Since the early 2000s, "Strategic Learning" (T5) publications have trended, remaining a popular topic. The focus of this topic has evolved from strategic alignment to strategic initiatives, long-term strategic learning, and, more recently, strategic adaptation, indicating that organizational learning is now recognized as a critical strategic competency for organizations.

Other topics have also changed rather noticeably. For example, over time the quantity of papers under "Innovation" (T1) and "Collaborative Learning" (T2) has progressively raised. Regarding innovation, the emphasis now is on disruptive innovation instead of product innovation; team-based learning has given way to worldwide cooperation networks via collaborative learning. AI-supported knowledge management has replaced information exchange in "Knowledge Management" (T0) studies. Analogous research on "Performance Improvement" (T7) has moved from efficiency enhancement to AI-driven performance optimization. "Leadership and Culture" (T3) has evolved from investigating the impact of leadership on culture to adaptive leadership, while "Change and Adaptation" (T8) has switched from change management to a rising focus in adaptable capability. In T11, "Sustainability" has grown from environmental learning to sustainable innovation, while in T12, "Organizational Learning Mechanisms" has moved from learning routines to process improvement.

This study shows the notable change the discipline of organizational learning has seen within the past thirty-five years. The field has been much shaped by technological developments, globalization, and changing corporate dynamics. Particularly the expanding relevance of technology and learning, human resources, and strategic learning hints to the future directions the discipline is probably to follow.

Network Analysis Results

The network analysis, based on dynamic topic modeling analysis correlations, helps explain evolution of the field and interrelationships between topic (see Figure 4). Centrality measures—degree centrality, betweenness centrality, and closeness centrality—are used to evaluate each topic's function, importance, and interaction within the network from several perspectives.

Degree Centrality Results

Degree centrality shows how important a topic is in the network and how well it connects to other topics. During specific periods, topics with a high degree of centrality in organizational learning research have emerged as focal points, with strong interactions across other themes. Table 2 shows that "Knowledge Management" (T0) and "Innovation" (T1) were highly central in 1990-1999, showing firms' focus on knowledge sharing and innovation.

"Knowledge Integration" (T13) and "Strategic Learning" (T5) increased in degree centrality from 2000 to 2004, indicating that firms were integrating knowledge systems and strategic learning processes.

The degree centrality of "Technology and Learning" (T4) increased sharply from 2010 to 2014. This shows that digital technologies are becoming more important in corporate learning and that digital transformation is at the center of this time. The degree centrality of "Sustainability" (T11) and "Learning Theories" (T9) has demonstrated a significant increase in the 2015-2019 and 2020-2024 periods, indicating the increasing significance of sustainability and theoretical advancements in the formation of strategic decisions within organizations. As new priorities and technology developments have arisen, the key issues of organizational learning research have shifted, and this analysis indicates how particular topics have developed in prominence over time.

Betweenness Centrality Results

Betweenness centrality indicates if a topic serves as a bridge in the network, allowing information to travel across different nodes (topics in this case). High betweenness centrality topics are bridges between different topics. Betweenness centrality of "Knowledge Integration" (T13) increased significantly from 2000 to 2004, indicating that knowledge systems became crucial for enterprises and that this topic connected other topics. In the 2010-2014 period, the "Technology and Learning" (T4) topic experienced a dramatic increase in betweenness centrality. Technology became crucial to information flow throughout the field during digital transformation, which may have affected organizational learning research.

The betweenness centrality of "Sustainability" (T11) and "Learning Theories" (T9) increased in the 2015–2019 and 2020–2024 periods, therefore highlighting their rising importance as main turning points in organizational learning. While learning theories capture the theoretical advances pushing companies to maximize their learning processes, sustainability reflects the increasing impact of social and environmental elements. This analysis shows how essential themes emerge at different times, connecting evolving research areas and impacting organizational learning.

Closeness Centrality Results

Closeness centrality reveals the closeness of a topic to other subjects in the network and its impact all throughout the network. Topics with a high degree of centrality are situated at the network's core and have robust connections to other topics.

The topic Organizational Learning Mechanisms (T12) is central to organizational learning processes and is strongly connected to all other topics, as evidenced by its high closeness centrality. This shows that organizational learning mechanisms topic promote knowledge sharing between other topics in the field. The rise in the closeness centrality of the Technology and Learning (T4) topic in the 2010–2014 and 2015–2019 periods indicates that this topic is linked with other topics and plays a central part in the organizational learning network. In the same vein, the growing closeness centrality of the topic Sustainability (T11) suggests that it is becoming more significant in the learning processes of organizations.

CONCLUSION AND DISCUSSION

This study demonstrates the evolution of the organizational learning field by evaluating the topics that were investigated between 1990 and 2024, as well as their roles within the field and the evolution of topics. This study used Dynamic Topic Modeling (DTM) and network analysis to determine the key patterns and how different parts of organizational learning have changed over time. The study's results are consistent with the theoretical frameworks and technological advancements that have been noted in the organizational learning literature. The results of the research will be examined in the context of the literature under the primary headings in this section.

Evolution of Knowledge Management

Knowledge management is a constantly evolving field that is important to modern enterprises' competitive advantage. In line with this reality in practice, the findings of this study show that knowledge management studies have played an important role in the organizational learning literature since the 1990s, and that knowledge management studies have undergone significant content change during the period under consideration. Nonaka and Takeuchi's (1995) theory of knowledge creation stresses how firms shape their knowledge management processes and the significance of these activities in gaining a competitive advantage. The conclusions of this study demonstrated that knowledge management began with knowledge sharing and storage, but by the 2020s had progressed into AI-enabled knowledge automation and decision-making.

Davenport and Kirby's (2016) "intelligent automation" paradigm is a key work that describes this shift in knowledge management. The authors investigate the role of AI and automation in knowledge management and describe how these technologies are changing information processing. Organizations must regard knowledge as a strategic asset and effectively administer it in order to undergo this transformation. Jarrahi (2018) highlights the

significance of ethical use of AI-enabled systems and human-machine collaboration while exploring the function of these systems in corporate decision-making processes. This demonstrates that information management is more than just a technology challenge; it also has ethical and societal implications.

Global disasters, such as the COVID-19 pandemic, have prompted organizations to reconsider their knowledge-management systems. According to Soto-Acosta (2020), the pandemic has expedited digital transformation, forcing enterprises to reconsider their knowledge management approaches. Similarly, Jarrahi (2018) investigates the impact of AI-enabled systems on knowledge management and demonstrates how these technologies speed up and modify organizational learning processes. George, Haas, and Pentland (2014) also discuss the impact of big data on knowledge management and highlight the potential for these technologies to speed organizational learning processes. This study demonstrates that the dynamic nature of knowledge management and its role in organizational learning evolve over time.

Innovation and Disruptive Technologies

The results of the research reveal that innovation processes have changed significantly over time and that this change has sped up especially with the development of disruptive technologies. At first, research in this area was mostly about coming up with new products. But over time, it has become more broad, covering ideas like disruptive innovation, innovation communities, and creativity management. This expansion demonstrates that innovation is no longer only about creating new products or services; it now includes significant changes that can redefine company structures, processes, and even entire industries.

Christensen's (1997) groundbreaking theory of "disruptive innovation" provided a comprehensive framework for how organizations respond to radical change, explaining why established companies can fail in the face of new technologies. The development of innovation throughout time and its increasing interdependence with other topics imply that different sectors can react differently to innovative technology and processes. King and Baatartogtokh (2015) conducted a comprehensive investigation into the ways in which disruptive innovation varies across various sectors. It is important to tailor methods to the specific dynamics of the examined sector, as the researchers stressed that disruptive innovation's effects vary among industries. They stress that in order for disruptive innovation to work in some areas, it is important to look at how quickly established players can adapt and how the market is structured. According to these results, innovation performance is affected by sector-specific variables, and disruptive innovation isn't a magic formula for all industries.

Emphasizing that innovation is no longer limited to R&D departments but rather a process across the entire company, Nambisan et al. (2019) in their analysis of how digital technologies change invention processes stress This change results in ever more entwined processes of organizational learning and invention. As a result, firms must develop learning cultures and efficiently utilize digital technologies in order to improve their innovation skills and achieve a competitive advantage. Furthermore, precisely evaluating the possible effects of disruptive innovation and creating plans in line with sectoral dynamics would help companies to effectively fit the reality of their times.

Strategic Learning and Leadership Transformation

To remain in a competitive climate and reach their long-term objectives, companies must practice strategic learning. This study found that strategic learning has changed over time, especially in recent years, towards more dynamic and future-oriented notions like strategic agility and foresight. This transformation is also substantiated by the network analysis results. In the early years, strategic learning (T5) showed a modest degree of centrality; yet, in the 2010–2014 and 2015–2019 periods this centrality value peaked. Stated differently, strategic learning has taken front stage in studies of organizational learning.

The significance of strategic learning highlights the necessity for organizations to cultivate the ability to continuously learn and adapt in order to thrive in the unpredictable and fast-paced business landscape of today. The theoretical framework for this transformation is provided by Teece et al.'s (2016) dynamic capabilities theory, which underscores the necessity of strategic agility for organizations to endure in this new reality. According to Haneberg (2021), this agility is essential for businesses to handle unpredictability with speed and effectiveness.

This transformation is also significantly influenced by the relationship between strategic agility, organizational learning, and leadership. The complexity leadership concept of Uhl-Bien and Arena (2022) argues that hierarchical leadership models are being replaced by more flexible, distributed, and collaborative ones. The capacity of leaders to make prompt decisions, manage uncertainty, and facilitate employees' learning and adaptation processes has become increasingly critical, particularly in the wake of the COVID-19 pandemic.

The Data-Driven Evolution of Performance Management

Studies on performance management have changed significantly during the 1990s, much as in other fields. Originally concentrating on performance evaluation, research have turned to data-driven performance optimization influenced by analytical techniques and big data. Emphasizing the use of data analytics in performance

management, Davenport et al. (2010) stated that such approaches give businesses competitive edge. Big data and analytics enable better employee performance evaluation and HR management.

These data-driven changes have raised ethical and social responsibility concerns. Research on ethical issues in the application of such technology and algorithmic decision-making procedures have exposed moral questions. For instance, Mittelstadt et al. (2016) underline how algorithms could take into account fundamental ethical values including justice, openness and responsibility. In their 2019 article, Greene, Hoffmann, and Stark (2019) discuss the moral implications of AI and big data and offer suggestions for how to use these tools responsibly.

The content of studies on this topic has changed throughout time, indicating that the relationship between performance management and organizational learning has grown more complex. Today, performance management seeks to generate learning and growth chances rather than only assessing employee performance. Companies need to think about ethical and social problems when they look at the pros and cons of data analytics and AI. They should also make sure that their evaluations of employees are fair and clear.

Sustainability and Organizational Learning

In the business world of today, sustainability is becoming more and more important. Organizational learning research also demonstrates this trend. Since the 1990s, the issue of sustainability has become increasingly prominent, with a climax in the period 2020-2024, as indicated by the results of this study. Reflecting the growing relevance of the issue in organizational learning, the number of studies on Sustainability (T11) rose dramatically in the 2015-2019 and 2020-2024 years as shown in Figure 3.

According to Eccles and Klimenko (2019), sustainability has evolved from an ethical imperative to a strategic tool for competitive advantage. The findings of the study are completely congruent with this viewpoint. Particularly in recent years, the issue of Sustainability (T11) has taken front stage in organizational strategies, emphasizing on sub-themes including "sustainable innovation" and "corporate sustainability." This demonstrates how actively competitive advantage is acquired using sustainability. Linnenluecke and Griffiths (2010) study on the relationship between corporate sustainability and organizational culture emphasizes the integration of sustainability objectives into organizational learning. This study illustrates a growing link between sustainability, innovation, and strategic learning. This suggests that organizations are effectively integrating sustainability objectives with learning strategies.

In recent years, sustainability-oriented innovation strategies have also gained importance. The study by Bohnsack et al. (2014) examines how sustainable technology business models have changed over time and how this shift affects organizational learning. In the same vein, Nambisan et al. (2019) underscored the importance of digital technologies in the development of sustainable innovation processes. The results of this study also show that, particularly in the year 2020–2024, the topic Sustainability (T11) supports this trend by stressing on the sub-theme "sustainable innovation." These advances show that, in terms of both fulfilling environmental and social obligations as well as obtaining competitive advantage, sustainable innovation has grown to be a major strategic focus for companies. Sustainability is no longer restricted to environmental and social responsibility projects; it is now regarded as a critical factor determining an organization's long-term success and competitiveness.

Technology and Learning: Transformation at the Heart of Organizational Learning

One of the study's most startling conclusions is the rapid advancement of technology and learning topic in the field of organizational learning. Since the 2010s, organizational learning studies have been centered on technology and learning, which were perceived as relatively isolated topics in the 1990s as shown in Figure 3. This shift clearly demonstrates the impact of digital technologies and artificial intelligence on organizational learning (George, Haas, & Pentland, 2014).

The examination of the sub-themes in which the content of technology and learning has been concentrated during various periods can provide a more comprehensive understanding of this change. Originally concentrating on simple technologies like e-learning systems and learning management systems, research have moved to more modern and sophisticated technologies including mobile learning, artificial intelligence, and customized learning environments. These results fit the research of Siemens and Gaševič (2015), who address how artificial intelligence speeds up and changes educational disciplines. In addition, the research on the impact of digital technology on business conducted by Brynjolfsson and McAfee (2014) sheds light on the ways in which this revolution has brought about significant shifts in the field. This rapid transition has led many scholars to claim that “technology is reshaping the way we learn and teach” and that “organizations need to adapt their learning strategies and practices to current technological developments” (Westerman et al., 2014).

Personalized learning experiences can be enhanced by technologies like artificial intelligence, big data, and learning analytics, which can improve the efficacy and efficiency of learning processes (Siemens & Gašević, 2015). These technologies can motivate and accelerate learning by providing information and learning pathways personalized to employees' needs and learning styles. By enabling more quantifiable and assessable learning processes, these technologies can also enable companies to better grasp the return on their investment in education

(Chui, Manyika, & Miremadi, 2016). Additionally, technologies like augmented reality (AR) and virtual reality (VR) enhance cognitive learning processes, enriching employees' learning experiences (Abubakar et al., 2019). To illustrate the concrete effects of these technologies, case studies from sectors highly impacted by digital transformation can be considered. For example, in the manufacturing industry, AI-powered automation has significantly enhanced employees' access to knowledge and problem-solving capabilities. Such examples underline the practical implications of this study's findings, showing the broad-reaching effects of digital transformation and AI on organizational learning.

The future success of businesses will depend on how well they handle this changing connection between technology and learning. Organizations have the potential to expand their capacity for learning through the utilization of digital technology, which will allow them to react more rapidly and effectively to shifting external conditions. This will support organizations in maintaining their competitive advantage and sustainable growth (Brynjolfsson & McAfee, 2014).

Conclusion

This study investigated the evolution and interaction of research topics in the field of organizational learning from 1990 to 2024. Using Dynamic Topic Modeling and network analysis, this study demonstrates the transformative effects of knowledge management, innovation, strategic learning, and technology on organizational learning. Especially in the last several years, ideas like sustainability, big data, and artificial intelligence have been driving the field's future developments. This study presents the dynamic and multidimensional nature of organizational learning in an objective way and provides a solid foundation for future research and applications.

Nevertheless, it is important to acknowledge the limitations of this study. The results of methods such as Dynamic Topic Modeling may vary depending on the researchers' choice of parameters and model configuration. Consequently, the objectivity of the results could be constrained and the conclusions should be seen as the outcome of methodological decisions. Furthermore, the study is based only on studies published in journals indexed by the Scopus database. Future research could contribute to a more holistic and in-depth view of the field by examining research in different languages and geographies.

For future research, it is suggested to examine topics such as the long-term effects of artificial intelligence and big data analytics on organizational learning, the integration of sustainability with learning strategies, the effects of global crises on learning processes, and the impact of cultural differences on organizational learning. Additional research in these fields can help to enhance theoretical knowledge and offer insightful analysis for useful purposes.

Acknowledgements

This manuscript was partially assisted by the use of generative AI programs for translation and language editing purposes.

REFERENCES

Abubakar, A. M., Elrehail, H., Alatailat, M. A., & Elçi, A. (2019). Knowledge management, decision-making style, and organizational performance. *Journal of Innovation & Knowledge, 4*(2), 104-114. https://doi.org/10.1016/j.jik.2018.03.001

Argote, L., & Miron-Spektor, E. (2011). Organizational learning: From experience to knowledge. *Organization Science, 22*(5), 1123-1137. https://doi.org/10.1287/orsc.1100.0621

Argyris, C., & Schön, D. A. (1978). *Organizational Learning: A Theory of Action Perspective*. Addison-Wesley.

Blei, D. M., & Lafferty, J. D. (2006). Dynamic topic models. In *Proceedings of the 23rd International Conference on Machine Learning* (pp. 113-120). https://doi.org/10.1145/1143844.1143859

Blei, D. M., Ng, A. Y., & Jordan, M. I. (2003). Latent Dirichlet Allocation. *Journal of Machine Learning Research, 3*, 993-1022. https://www.jmlr.org/papers/volume3/blei03a/blei03a.pdf

Bohnsack, R., Pinkse, J., & Kolk, A. (2014). Business models for sustainable technologies: Exploring business model evolution in the case of electric vehicles. *Research Policy, 43*(2), 284-300. https://doi.org/10.1016/j.respol.2013.10.014

Brynjolfsson, E., & McAfee, A. (2014). *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*. W. W. Norton & Company.

Burnham, J. F. (2006). Scopus database: A review. *Biomedical Digital Libraries, 3*, 1. https://doi.org/10.1186/1742-5581-3-1

Carnevale, J. B., & Hatak, I. (2020). Employee adjustment and well-being in the era of COVID-19: Implications for human resource management. *Journal of Business Research, 116*, 183-187. https://doi.org/10.1016/j.jbusres.2020.05.037

Christensen, C. M. (1997). *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail*. Harvard Business School Press.

Chui, M., Manyika, J., & Miremadi, M. (2016). Where machines could replace humans—and where they can't (yet). *McKinsey Quarterly*. Retrieved from https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/where-machines-could-replace-humans-and-where-they-cant-yet

Coraiola, D. M., & Murcia, M. J. (2020). From organizational learning to organizational mnemonics: Redrawing the boundaries of the field. *Management Learning, 51*(2), 227-240. https://doi.org/10.1177/1350507619878823

Crossan, M. M., Lane, H. W., & White, R. E. (2011). An organizational learning framework: From intuition to institution. *Academy of Management Review, 24*(3), 522-537. https://doi.org/10.5465/amr.1999.2202135

Cyert, R. M., & March, J. G. (1963). *A Behavioral Theory of the Firm*. Prentice-Hall.

Davenport, T. H., & Kirby, J. (2016). *Only Humans Need Apply: Winners and Losers in the Age of Smart Machines*. Harper Business.

Davenport, T. H., Harris, J. G., & Shapiro, J. (2010). Competing on talent analytics. *Harvard Business Review, 88*(10), 52-58.

Dwivedi, Y. K., Hughes, D. L., Ismagilova, E., Aarts, G., Coombs, C., Crick, T., Galanos, V., et al. (2021). Artificial Intelligence (AI): Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice, and policy. *International Journal of Information Management, 57*, 101994. https://doi.org/10.1016/j.ijinfomgt.2019.05.002

Eccles, R. G., & Klimenko, S. (2019). The investor revolution. *Harvard Business Review, 97*(3), 106-116.

Easterby-Smith, M. (1997). Disciplines of organizational learning: Contributions and critiques. *Human Relations, 50*(9), 1085-1113. https://doi.org/10.1177/001872679705000903

Everitt, B. S., Landau, S., Leese, M., & Stahl, D. (2011). *Cluster Analysis* (5th ed.). Wiley.

García-Morales, V. J., Lloréns-Montes, F. J., & Verdú-Jover, A. J. (2007). Influence of personal mastery on organizational performance through organizational learning and innovation in large firms and SMEs. *Technovation, 27*(9), 547-568. https://doi.org/10.1016/j.technovation.2007.05.004

George, G., Haas, M. R., & Pentland, A. (2014). Big data and management. *Academy of Management Journal, 57*(2), 321–326. https://doi.org/10.5465/amj.2014.4002

Greene, D., Hoffmann, A. L., & Stark, L. (2019). Better, nicer, clearer, fairer: A critical assessment of the movement for ethical artificial intelligence and machine learning. In *Proceedings of the 52nd Hawaii International Conference on System Sciences* (pp. 2122-2131). https://doi.org/10.24251/HICSS.2019.257

Griffiths, T. L., & Steyvers, M. (2004). Finding scientific topics. *Proceedings of the National Academy of Sciences, 101*(Suppl 1), 5228-5235. https://doi.org/10.1073/pnas.0307752101

Haneberg, L. (2021). *The Agile Leader: How to Create an Agile Business in the Digital Age*. Kogan Page.

Hatch, N. W., & Dyer, J. H. (2004). Human capital and learning as a source of sustainable competitive advantage. *Strategic Management Journal, 25*(12), 1155-1178. https://doi.org/10.1002/smj.421

Huber, G. P. (1991). Organizational learning: The contributing processes and the literatures. *Organization Science, 2*(1), 88-115. https://doi.org/10.1287/orsc.2.1.88

Jarrahi, M. H. (2018). Artificial intelligence and the future of work: Human-AI symbiosis in organizational decision making. *Business Horizons, 61*(4), 577-586. https://doi.org/10.1016/j.bushor.2018.03.007

Jiménez-Jiménez, D., & Sanz-Valle, R. (2011). Innovation, organizational learning, and performance. *Journal of Business Research, 64*(4), 408-417. https://doi.org/10.1016/j.jbusres.2010.09.010

King, A. A., & Baatartogtokh, B. (2015). How useful is the theory of disruptive innovation? *MIT Sloan Management Review, 57*(1), 77-90.

Levitt, B., & March, J. G. (1988). Organizational learning. *Annual Review of Sociology, 14*, 319-340. https://doi.org/10.1146/annurev.so.14.080188.001535

Levitt, B., & March, J. G. (2017). Organizational learning. *Annual Review of Sociology*, 14, 319-340. https://doi.org/10.1146/annurev.so.14.080188.001535

Li, Y., Tang, G., & Chen, Y. (2022). AI-enabled learning and performance improvement in organizations: An integrative framework. *Journal of Business Research, 146*, 148-158. https://doi.org/10.1016/j.jbusres.2022.03.035

Linnenluecke, M. K., & Griffiths, A. (2010). Corporate sustainability and organizational culture. *Journal of World Business, 45*(4), 357-366. https://doi.org/10.1016/j.jwb.2009.08.006

Manning, C. D., Raghavan, P., & Schütze, H. (2008). *Introduction to Information Retrieval*. Cambridge University Press.

March, J. G. (1991). Exploration and exploitation in organizational learning. *Organization Science, 2*(1), 71-87. https://doi.org/10.1287/orsc.2.1.71

Mimno, D., Wallach, H. M., Talley, E., Leenders, M., & McCallum, A. (2011). Optimizing semantic coherence in topic models. In *Proceedings of the Conference on Empirical Methods in Natural Language Processing* (pp. 262-272). https://doi.org/10.1007/978-3-642-36883-6_27

Mittelstadt, B. D., Allo, P., Taddeo, M., Wachter, S., & Floridi, L. (2016). The ethics of algorithms: Mapping the debate. *Big Data & Society, 3*(2), 2053951716679679. https://doi.org/10.1177/2053951716679679

Nambisan, S., Wright, M., & Feldman, M. (2019). The digital transformation of innovation and entrepreneurship: Progress, challenges and key themes. *Research Policy, 48*(8), 103773. https://doi.org/10.1016/j.respol.2019.03.018

Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science, 5*(1), 14-37. https://doi.org/10.1287/orsc.5.1.14

Nonaka, I., & Takeuchi, H. (1995). *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*. Oxford University Press

Omotehinwa, T. O. (2022). Organizational learning and development in the 21st century. *Journal of Learning and Development Studies*, 45(2), 115-132.

Pittaway, L., Robertson, M., Munir, K., Denyer, D., & Neely, A. (2004). Networking and innovation: A systematic review of the evidence. *International Journal of Management Reviews, 5-6*(3-4), 137-168. https://doi.org/10.1111/j.1460-8545.2004.00101.x

Popova-Nowak, I. V., & Cseh, M. (2015). The meaning of organizational learning: A meta-paradigm perspective. *Human Resource Development Review, 14*(3), 299-331. https://doi.org/10.1177/1534484315595965

Řehůřek, R., & Sojka, P. (2010). Software framework for topic modelling with large corpora. In *Proceedings of the LREC 2010 Workshop on New Challenges for NLP Frameworks* (pp. 45-50).

Robey, D., Boudreau, M. C., & Rose, G. M. (2000). Information technology and organizational learning: A review and assessment of research. *Accounting, Management, and Information Technologies*, 10(2), 125-155. https://doi.org/10.1016/S0959-8022(00)00004-6

Schilling, J., & Kluge, A. (2009). Barriers to organizational learning: An integration of theory and research. *International Journal of Management Reviews, 11*(3), 337-360. https://doi.org/10.1111/j.1468-2370.2008.00242.x

Seetharaman, P. (2020). Business models shifts: Impact of COVID-19. *International Journal of Information Management, 54*, 102173. https://doi.org/10.1016/j.ijinfomgt.2020.102173

Shrestha, Y. R., Ben-Menahem, S. M., & von Krogh, G. (2019). Organizational decision-making structures in the age of artificial intelligence. *California Management Review, 61*(4), 66-83. https://doi.org/10.1177/0008125619862257

Siemens, G., & Gašević, D. (2015). Learning analytics and educational data mining: Towards communication and collaboration. In *Proceedings of the 5th International Conference on Learning Analytics and Knowledge* (pp. 252-255). https://doi.org/10.1145/2723576.2723620

Soto-Acosta, P. (2020). COVID-19 pandemic: Shifting digital transformation to a high-speed gear. Information Systems Management, 37(4), 260-266. https://doi.org/10.1080/10580530.2020.1814461

Teece, D. J., Peteraf, M. A., & Leih, S. (2016). Dynamic capabilities and organizational agility: Risk, uncertainty, and strategy in the innovation economy. *California Management Review, 58*(4), 13-35. https://doi.org/10.1525/cmr.2016.58.4.13

Tranfield, D., Denyer, D., & Smart, P. (2003). Towards a methodology for developing evidence-informed management knowledge by means of systematic review. *British Journal of Management, 14*(3), 207-222. https://doi.org/10.1111/1467-8551.00375

Uhl-Bien, M., & Arena, M. (2022). Complexity leadership: Enabling people and organizations for adaptability. *Journal of Organizational Behavior, 43*(7), 1093-1112. https://doi.org/10.1002/job.2562

Wasserman, S., & Faust, K. (1994). *Social Network Analysis: Methods and Applications*. Cambridge University Press.

Westerman, G., Bonnet, D., & McAfee, A. (2014). *Leading Digital: Turning Technology into Business Transformation*. Harvard Business Review Press.