Leadership-competences in the era of artificial intelligence – a structured review

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Abstract

Purpose – Artificial intelligence (AI) will transform various processes by utilizing and sharing data and information. This transformation brings new opportunities and challenges to organizations. Effective leadership is essential to handle these changes. However, there is no scientific research on how AI affects the everyday lives of managers. Therefore, this paper aims to identify how AI can affect changes in the skills and personality traits of managers using AI.

Design/methodology/approach – A structured literature review identified leadership competencies relevant to the AI era. Three scientific databases were included in the search: (I) Scopus, (II) EBSCO Business Source Complete, and (III) Web of Science. A total of 730 articles were identified from the three databases under the topics "Digital Leadership," "Leadership" AND "Artificial Intelligence," "Future Leadership," "Algorithm Leadership," "AI Leadership," "Artificial Leadership," and "Data-driven Leadership."

Findings – A total of 24 leadership competencies, including 12 personality traits and 12 skills, were identified from the literature. To adapt effectively to AI, leaders should focus on developing communication skills and forming high-performance teams working cross-functionally and in a symbiosis of humans and machines.

Originality/value – The article adds knowledge to leadership theories and provides a basis for future management education.

Keywords Algorithm Leadership, Artificial Intelligence, Leadership competences, Role of Managers, Systematic literature review

Paper type Literature review

1. Introduction

The business world is undergoing a transformation that is reshaping industries, redefining job roles, and revolutionizing how organizations operate (Kollmann et al., 2023; Davenport and Ronanki, 2018). At the epicenter of this transformation is the relentless advance of artificial intelligence (AI) and machine learning technologies. Once confined to science fiction, these technologies have emerged as potent tools, enabling businesses to automate repetitive tasks, analyze massive data sets, and gain unprecedented insights (Wilson and Daugherty, 2018). Organizations implementing AI applications are expected to benefit from added business value, such as increased revenue, cost reduction, and improved business efficiency (AlSheibani et al., 2020). In the process, they are fundamentally altering the traditional landscape of management.

In the era of artificial intelligence, managers are finding themselves at a critical juncture. The skills and traits that have long been the bedrock of effective management are facing formidable challenges and must evolve to meet the demands of this new business landscape. As AI systems increase across industries, understanding their capabilities, harnessing their potential, and mitigating their risks become prerequisites for successful leadership. This

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transformation brings new opportunities and challenges for organizations based on the manager's values and expectations (Forst and Jeske, 2019). Competent leadership with the right attitude will be essential to successfully handle these changes (Chamorro-Premuzic et al., 2018; Pearce, 2018; Reynolds, 2018).

Artificial leadership utilizes AI systems to perform leadership tasks by processing big data, employing deep learning algorithms, and making objective, data-driven decisions. While AI excels in automation and strategic exploration within defined frameworks, its effectiveness depends on high-quality data and it is limited in its transformative creativity beyond existing paradigms (Kollmann et al., 2023).

AI and humans act together in a socio-technical system. For the definition of this system, the definition of Ropohl (2009, p. 77) is used, which says, *"A system is a model of a whole that (a) has relationships between attributes (input, output, states etc.), which (b) consists of interconnected parts or subsystem* – social and technical – *and which (c) is delimited from its environment or a subsystem."* This system consists of four elements: (1) structure and (2) people on the social side of the system, (3) technology, and (4) process on the technical side of the system (Ulich, 2011).

Previous studies discuss the importance of managers appropriately facing AI challenges (e.g. De Cremer, 2019; Petrucci and Rivera, 2018). However, there is no scientific research on how AI affects the everyday lives of managers. This paper aims to identify how AI can affect changes in the skills and personality traits of managers using AI.

This analysis is done by identifying essential personality traits and skills of leaders through the existing literature and determining which are helpful in the era of AI. The aim is to add to current knowledge about leadership and provide a basis for future management education. The output of this paper could lead to a better understanding of the subject.

2. Theoretical background

Frey and Osborne (2013) note that using sophisticated algorithms in routine, intense jobs will lead to declining employment rates as machines take over routine processes. However, digital transformation can also make low-skilled workers more efficient by providing new ways to solve problems, be creative, and coordinate tasks (Autor and Dorn, 2013).

The decreasing prices of IT infrastructure have accelerated the pace of digital transformation (Frey and Osborne, 2013). This development has enabled companies to advance the computerization of routine tasks, allowing employees to specialize in non-routine tasks to enhance their effectiveness (Peng and Eunni, 2011). Brynjolfsson and McAfee (2012) argue that AI is more significant in transforming non-routine tasks into computerized algorithms. These algorithms can think and learn, fulfilling non-routine tasks and leading to more efficient communication between leaders and their teams (e.g. Gonciarski and Switkowaski, 2018; Huang et al., 2019; Sprenger, 2018; Wright and Schultz, 2018; Russell and Norvig, 2016).

The increasing role of AI in decision-making and problem-solving tasks, which are typically management tasks, may require new management and leadership styles (Larjovuori et al., 2018; Martin, 2005). AI-led supervision and management may also become a reality; thus, it may be necessary for human-AI collaboration to guide programmers and influence machine decisions (Smith and Green, 2018). However, while AI is capable of analytical decision-making, a symbiotic relationship between humans and machines may be the most effective approach for daily business operations (Jarrahi, 2018). Pugliese et al. (2015) found that autonomous computers are non-functional without human leadership. This symbiotic relationship may require new leadership and management styles that promote cooperation and communication between humans and machines.

According to several sources, the development of AI will bring significant changes that will require effective change leadership at all levels of an organization. Moldenhauer and Londt (2019) suggest that AI will provide opportunities for innovation in technology and engineering. However, this will require new skills from managers, including problem-solving, people-managing, collaborating, creativity, decisiveness, and adaptiveness. De Cremer (2019) questions whether leadership will still be relevant in the era of AI but calls for leaders to perform their roles in a collaborative, creative, decisive, agile, and flexible way. Chamorro-Premuzic et al. (2018) argue that AI will lead to a greater emphasis on managers' soft skills, such as visionary thinking, agility, and adaptiveness. Pearce (2018) emphasizes the importance of leadership change in shaping the introduction of AI, recommending that leaders evolve in their technical skills, networking ability, collaboration through empathy, and employee empowerment through coaching. Dewhurst and Willmott (2014) suggest that future leaders must communicate effectively with humans and machines, asking the right questions and being aware of their followers while having a creative solution-oriented mindset. Petrucci and Rivera (2018) propose that future digital leaders should foster collaboration and innovation by bringing together vertically integrated, cross-functional teams, ensuring continuous communication with and empowerment for their teams. Gonciarski and Switkowaski (2018) see a strong impact on the work of managers due to the digital transformation through new ICT and propose that a digital manager should be aware of their followers, develop recursive thinking to promote creativity, act as a visionary in an agile way, empower their followers, and be present and listening.

In conclusion, the impact of digital transformation and AI on companies is significant and multifaceted. While adopting AI may increase productivity and efficiency, it is essential to recognize the need for collaboration and communication between humans and AI for optimal performance. This symbiotic relationship may require new leadership and management styles that promote cooperation and communication between humans and machines. The studies reviewed in this section suggest that effective change leadership is essential for organizations to succeed in the era of AI. To direct this change process, managers must possess various skills, including soft skills, technical skills, visionary thinking, and effective communication.

3. Methodology

3.1 Review planning

This study opted for an evidence-informed, systematic literature review approach to address the limitations associated with narrative reviews (Tranfield and Denyer, 2003) and expert reviews with ad hoc literature selection (Kitchenham et al., 2009). A model for a systematic qualitative literature review from Kitchenham (2004) was chosen. The review process is divided into three phases: (1) planning the review, (2) collecting the data for review and (3) performing the data analysis.

3.2 Data collection and analysis

In data collection phase of the review, a list of selected publications and extracted data from each relevant publication were generated (Staples and Niazi, 2007). The remaining studies and articles were classified (Staples and Niazi, 2007) as primary relevant (i.e., sources that provided essential information for coding of leadership-competences) or secondary relevant sources (i.e., sources which deliver necessary background information about how AI will change leadership).

The analysis identified themes, patterns, and relationships in the sources (Saunders et al., 2016). Content analysis, as Hsieh and Shannon (2005) propose, involved coding articles and

studies to identify comparable structures in all documents. In the coding process, a scheme which outlines the categories or codes relevant to the research question was defined. To determine the codes, all skills and personal traits that could not be briefly assigned to one of the codes schemes were collected. Next, they were merged into new categories. An initial list of codes/categories was created and summarized in short phrases.

3.3 Research question

Indeed, a well-formulated research question is a fundamental aspect of a proper systematic literature review. It serves as a guiding principle for the entire study and helps to focus the research efforts. Bryman (2007) emphasizes that devising a research question is instrumental in selecting appropriate research strategies and methods, effectively laying the foundation for the entire research.

Besides ethical issues with AI (e.g. Parry et al., 2016) and regional and cultural changes (Kazim, 2019; Sasmoko et al., 2019; Schwarzmüller, et al., 2018), Kosslyn (2019) claims that the research should focus less on how people interact with technology, and more on what skills people can acquire that machines will be unable to do in the near future. Further, he advises focusing on skills that are hardest to understand and systematize for AI, as these will give humans an edge over robots. To better clarify how digitalization's multidimensional phenomenon affects organizations and leadership, Cortellazzo et al. (2019) describe the potential for future reviews to include industry research reports and professional outlets publishing research-based findings and other non-peer-reviewed literature. Larjovuori et al. (2018) see potential in researching the role and effects of different leadership styles in digital business development. They recommend a more detailed understanding of first-line managers' varying roles, human resource management, and top management in the change process. In addition, Buxmann et al. (2019) call for research into *"What are AI's possible effects on organisational governance and hierarchy, structure, and processes?"* (p. 546). In the same vein, Cortellazzo et al. (2019) identified the potential for further research on *"whether and how robots, algorithms and technological tools substitute or complement leaders"* (p. 16). Russell et al. (2015) highlighted that the lack of leadership provides an imperative to develop leadership theory to lead and manage the AI technology effectively.

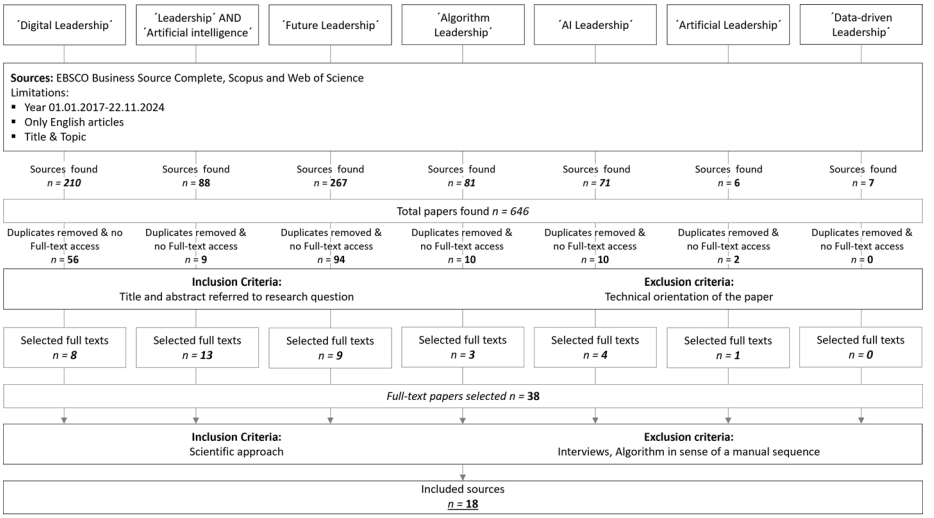
The present review illuminates some of these gaps by considering all relevant literature and analyzing how middle managers' tasks are affected by AI. The literature review has identified a significant and practically applicable research gap: There is a need to adjust leadership development to provide managers with competencies for AI use. Based on the motivation expressed in the introduction of this paper and on the literature review, the research question can be stated as follows:

RQ1. Which competencies are relevant for managers in the era of AI?

3.4 Data sample and collection

Figure 1 depicts that three broad scientific databases, covering the period from 01.01.2017 to 22.11.2024, were included in the search: (I) Scopus, (II) EBSCO Business Source Complete, and (III) Web of Science.

The EBSCO databases were the main source for the literature because of the quality of the available reports and papers. According to Staples and Niazi (2007), research planning should produce a systematic review protocol that defines the relevant and irrelevant literature. The search was conducted under three criteria: (1) Period restriction was used to



Source: Authors' own work

Figure 1. Search protocol and source selection process

exclude old and irrelevant articles, (2) only English-language articles were considered, and (3) the search restrictions "title" and "topic" were used to reduce irrelevant results.

3.5 Analytical techniques

A total of 730 articles were identified from the three databases under the topics "Digital Leadership," "Leadership," "Artificial intelligence," "Future Leadership," "Algorithm Leadership," "AI Leadership," "Artificial Leadership" & "Data-driven Leadership." Table 1 displays the search criteria and the number of articles for each database and topic.

All the information about the search results, including the database, name of the publication, and authors, was summarized in the research protocol. For the first selection, the duplicates (173) and inaccessible articles (8) were excluded, leaving 549 articles. Next, the titles and abstracts were read. This step excluded 511 articles that were not relevant to the research theme.

Table 1. Search criteria and the number of articles per database

Search criteria	Scopus	EBSCO business source complete	Web of science	Total
"Digital leadership"	97	68	45	*210*
"Leadership" and "artificial intelligence"	4	19	65	*88*
"Future leadership"	14	124	126	*267*
"Algorithm leadership"	1	80	0	*81*
"AI leadership"	30	3	6	*71*
"Artificial leadership"	4	2	0	*6*
"Data-driven leadership"	5	0	2	*7*
				730

Source: Authors' own creation

The remaining 38 articles were read in full to ensure their content was relevant to this study. Fifteen relevant articles, identified using the structured literature search, contained evaluable competencies. These 17 articles were appropriate for the coding to identify necessary leadership competencies of managers in the era of digital transformation and AI.

4. Results

4.1 Coding of the literature

The literature review shows that there are many different descriptions and terms for tasks, skills, and roles in the era of AI. Dewhurst and Willmott (2014) use the terminology "future leaders," while Petrucci and Rivera (2018) use the term "digital leaders," and Gonciarski and Switkowaski (2018) speak of "digital managers." De Cremer (2020) uses the terminology "AI leadership" or "leadership in the era of AI." This term is used below to create uniformity with the algorithm management tasks.

Competencies and tasks were clustered by personality trait or skill to structure the competencies described in the sources and understand which of the required competencies can be learned (skills) as opposed to those that are more habitual (trait). Roberts and Mroczek (2008) and Villanueva (2010) describe traits as habitual patterns of behavior, thoughts, and emotions. According to this perspective, traits are relatively stable over time. However, they differ among individuals and influence their actions. Thus, while skills can be learned, personality traits require a change in thoughts, feelings, and behaviors.

4.2 Discussion

In this section, I answer the research question: "Which competencies are relevant for managers in the era of AI?"

Table 2 is the matrix of all identified codes and their number of occurrences in the 17 analyzed articles. For the coding and analyses of the literature, NVivo12 plus was used. The following table shows a detailed overview of the coded articles and the skills and personality traits that occur in each.

A total of 24 leadership competencies, including 12 personality traits and 12 skills, were identified from the literature and are listed below. The definition of the competencies was based on established management literature such as Northouse (2015) and Graeff (1993). In addition, these were supplemented with descriptions and examples from the analyzed literature:

- Adaptiveness is the ability to adapt to one's circumstances or environment. In the literature, it is often also described as the ability of a leader to design the necessary change process (Pfeifer et al., 2022; Gilli et al., 2023).
- Agility is the ability to think and understand quickly and includes responding rapidly to customer requirements (Gonciarski and Switkowaski, 2018).
- Awareness is the knowledge that something exists or the understanding of a situation or subject based on information or experience. It includes a sense of oneself and the impact on others (Northouse, 2015).
- Communicating is imparting or exchanging information by speaking, writing, or using another medium.
- Collaboration means that two or more parties work together for a specific purpose. Leaders with this skill unite and influence cross-functional teams (Petrucci and Rivera, 2018; Gilli et al., 2023).

Table 2. Leadership competencies in the era of AI by rate of occurrence

Source	Competencies Personality traits Adaptiveness	Agility	Awareness	Creativity	Decisiveness	Empathy	Engagement	Flexibility
Bersin (2018)	X	X			X			
Chamorro-Premuzic et al. (2018)	X	X	X	X			X	X
Cortellazzo et al. (2019)	X		X	X	X			
De Cremer (2019)		X		X	X	X		X
Dewhurst and Willmott (2014)			X	X				
Du et al. (2023)			X		X			
Gilli et al. (2023)	X		X		X	X		
Gonciarski and Switkowaski (2018)		X		X				
Kolbjørnsrud et al. (2016)				X	X	X		
Larjovuori et al. (2018)	X	X		X				
Moldenhauer and Londt (2018)	X		X	X	X	X		X
Pearce (2018)				X	X	X		
Petrucci and Rivera (2018)	X	X						
Pfeifer et al. (2022)	X				X			
Reynolds (2018)	X	X	X				X	
Sejera and Bocarnea (2022)								
Sposato (2024)		X			X			
Total references	*9*	*8*	*7*	*9*	*10*	*5*	*2*	*3*

Source: Authors' own creation

(*continued*)

Source	Competencies								
	Personality traits					Skills			
	Self-awareness	Situational understanding	Solution orientation	Visionariness	Collaborating	Communication	Discipline	Delegating
Bersin (2018)					X	X		X
Chamorro-Premuzic et al. (2018)				X	X	X	X	
Cortellazzo et al. (2019)		X	X	X	X	X		
De Cremer (2019)					X			
Dewhurst and Willmott (2014)			X			X		
Du et al. (2023)			X		X			
Gilli et al. (2023)					X			
Gonciarski and Switkowaski (2018)				X	X			
Kolbjørnsrud et al. (2016)					X	X		
Larjovuori et al. (2018)		X		X	X			
Moldenhauer and Londt (2018)	X		X		X			
Pearce (2018)				X	X			
Petrucci and Rivera (2018)				X	X	X		
Pfeifer et al. (2022)					X			
Reynolds (2018)		X	X	X	X			
Sejera and Bocarnea (2022)			X	X		X		
Sposato (2024)				X	X	X		
Total references	*1*	*3*	*6*	*9*	*15*	*8*	*1*	*1*

(*continued*)

Source	Empowerment	Executing	Liaison	Listening	Competencies Skills Motivation	People managing	Technical understanding	Follower valuation
Bersin (2018)	X							
Chamorro-Premuzic et al. (2018)			X					
Cortellazzo et al. (2019)	X		X	X	X		X	
De Cremer (2019)								X
Dewhurst and Willmott (2014)	X	X			X			
Du et al. (2023)	X				X		X	
Gilli et al. (2023)	X				X		X	
Gonciarski and Switkowaski (2018)	X			X			X	
Kolbjørnsrud et al. (2016)	X	X	X					
Larjovuori et al. (2018)	X	X	X		X			
Moldenhauer and Londt (2018)					X	X	X	X
Pearce (2018)	X					X	X	X
Petrucci and Rivera (2018)	X	X						
Pfeifer et al. (2022)	X						X	
Reynolds (2018)	X	X			X			
Sejera and Bocarnea (2022)	X				X			
Sposato (2024)	X		X			X	X	
Total references	*14*	*5*	*5*	*1*	*8*	*3*	*8*	*3*

- Creativity is the quality of thinking outside the box or "blue-sky thinking," as Moldenhauer and Londt (2019) state. It involves using one's imagination to develop original ideas.
- Decisiveness is making decisions quickly and effectively (Moldenhauer and Londt, 2019) and taking responsibility even if the basis for the decision is unclear; for example, if there is a lack of transparency into the decision-making process of an AI.
- Delegating refers to giving others jobs to perform on your behalf. It requires making strategic decisions, which is one of the primary roles of managers (Graeff, 1993).
- Disciplining is training others to obey rules or a code of behavior using punishment to correct disobedience.
- Empathy is the ability to understand and share the feelings of another. It is also described as the ability to see the world from another's point of view (Spears and Lawrence, 2002). Often, it is described as the ability to be aware and solve anxiety caused by new technology (e.g. Sejera and Bocarnea, 2022).
- Empowerment involves providing team members with opportunities for career development, skills acquisition (Spears and Lawrence, 2002) and encouraging them to contribute to discussions and consider alternative ways of problem-solving (Kouzes and Posner, 2017).
- Engagement is the possession of a strong personal interest in something. It often leads to more effective performance (e.g., Avolio and Gardner, 2005).
- Execution is about performing something in a planned way. Chamorro-Premuzic et al. (2018) define it as the ability to meet challenges by focusing on learning rather than being right. It leads to more effective execution, for example, taking quick action to implement a new technology (Reynolds, 2018).
- Flexibility is the ability to adapt one's strategies to meet new and unexpected conditions (Moldenhauer and Londt, 2019).
- Team member evaluation is the ability to recognize and meet others' needs before they are articulated. It also includes the ability to treat each team member as a unique person (Spears and Lawrence, 2002).
- Liaising refers to developing significant networks outside one's organization (Mintzberg, 1973) and is a crucial skill, especially for top management.
- Listening is the skill to give attention to someone or something.
- People-managing is handling others while understanding their needs.
- Motivating is making someone else eager to do something. In the context of leadership theories, Graeff (1993) describes it as promoting a willingness to exert considerable effort on the organization's behalf.
- Self-awareness is the conscious knowledge of one's character and feelings.
- Situational understanding is the knowledge of the current economic situation and the ability to highlight and explain deviations between the current and desired state. It also involves the ability to project what is coming in the future based on the present and past (Spears and Lawrence, 2002).
- Solution orientation involves an eagerness to identify and address complex problems. It involves a structured approach to working through complex issues (Moldenhauer and Londt, 2019).

- Technical understanding in the AI context means knowing how AI can streamline processes, mitigate implications, enhance operational efficiencies across functions, and implement AI-driven tools for data analysis and better decision-making (Sposato, 2024; Pearce, 2018).
- Being a visionary is imagining how a country, society, or industry will develop and planning accordingly. It also gives team members a clear direction (Northouse, 2015). Often, it is described as openness to innovation or responsiveness to trends (e.g., Gilli et al., 2023).

Of the 17 coded sources, 16 defined collaboration as a relevant skill in the era of AI. Amongst the cross-functional work of teams in which the leader must unite and influence the team members (Chamorro-Premuzic et al., 2018; Moldenhauer and Londt, 2019; Petrucci and Rivera, 2018), he must also be able to collaborate with the machines and secure the use of algorithms (De Cremer, 2019). The agility trait is justified as relevant for future managers by the statement that the company will respond to industry disruption by fostering a transformative culture (Chamorro-Premuzic *et al.*, 2018). In the analyzed literature, agility is often associated with flexibility (e.g. Larjovuori et al., 2018) and being able to respond quickly to customer requirements (Gonciarski and Switkowaski, 2018). Creativity is vital for future leaders to handle the changing environment. Managers must promote and foster creativity to lead cultural change and create a culture that cultivates innovation in their teams (De Cremer, 2019; Larjovuori et al., 2018). Besides fostering creativity, managers should be able to empower their team members, encouraging them to be active and autonomous by stepping into the role of a coach (Larjovuori et al., 2018; Pearce, 2018) and a trainer (Petrucci and Rivera, 2018). Empowering employees requires the manager to give the employees a goal to work toward. This often goes with an entrepreneurial and innovative spirit (Chamorro-Premuzic et al., 2018) and is defined as a trait of visionaries. As an inspirational and visionary leader, a manager must focus on innovation and inspire team members (Pearce, 2018).

To handle the sweeping changes that AI will cause, Reynolds (2018) emphasizes the importance of effective change leadership, using the term “management of change.” He discusses the managerial tasks and characteristics that must be considered at all organizational levels. Reynolds's statements are based on a customer survey, dispensing with literature references and existing leadership models.

Kolbjørnsrud et al. (2016) consider it necessary for leaders to be creative, collaborative, networked and experimental in the future. Similar to Reynolds (2018), Kolbjørnsrud et al. (2016) based their suggestions on a customer survey. Their summary states that managers' jobs are changing toward a focus on things only humans can do (Kolbjørnsrud et al., 2016).

Moldenhauer and Londt (2019) write that AI development will allow a change from routine to innovative job-related functions in technical and engineering fields. Such innovation will require new skills from the management of a company. Among other skills and traits, Moldenhauer and Londt (2019) list problem-solving, people-managing, collaborating and creativity, decisiveness, and adaptiveness as relevant in the era of AI. They conclude that failing to use new technologies and to change leadership will inevitably lead to organizational failure. They see the application of the tasks and competencies as a competitive advantage for organizations and plead to adapt them in leadership development programs and training. However, they do not show how the tasks and competencies were determined.

De Cremer (2019) describes how machine learning and AI will impact organizations’ work. He questions whether leadership will still be relevant in the era of AI and combines

this with the question of which jobs AI could do in the future. Generally, De Cremer (2019) expects AI to take over leadership roles. He predicts that management will perform their leadership roles by being collaborative, creative, decisive, agile, and flexible. Finally, De Cremer (2019) claims that future leaders must deal with the emotions of employees in an empathetic way. In his first publication on the topic, he deals superficially with the necessary properties. Still, he goes much deeper into the effects, backgrounds and essential changes in leadership in his 2020 published book (c.f. De Cremer, 2020).

Along with promoting the awareness of employee needs, supporting collaboration, and fostering communication, Chamorro-Premuzic et al. (2018) conclude that AI will lead to a greater emphasis on soft skills. They describe future leaders as visionary people who will offer followers meaningful answers in a disruptive environment. These leaders must be agile, flexible, and adaptive (Chamorro-Premuzic et al., 2018). They derive the tasks and characteristics required from executives based on company examples and interviews with organizations that are already affected by digitization. However, like the other articles reviewed, they do not answer the question of "who is affected by the change or which hierarchy and to what extent" or "how those affected should learn the characteristics and tasks."

Similarly, Pearce (2018) points out that AI's introduction will significantly impact leaders. To shape AI's introduction, she recommends that leaders evolve in their technical skills, networking ability, collaboration through empathy, and employee empowerment through coaching. Their social and innovative skills should inspire their team members. Pearce (2018) emphasizes the importance of leadership change by saying that almost every aspect of the business will be impacted and that the impact cannot be avoided. Nonetheless, she, too, is satisfied with a superficial description and provides no references to any article aimed at a practice-oriented audience.

Dewhurst and Willmott (2014) believe that future leaders' essential skills will be communicating between humans and humans-to-machines. Moreover, the ability to ask the right questions will significantly grow in importance. Asking the right questions of the right people at the right time is still a skill that computers lack. Machines can monitor risks and will become better and better at telling the management when they have a problem. However, the decision should still be a task for the leaders. Alternatively, machines should offer their recommended decision only after executives determine the level of risk with which they are comfortable. This requires awareness of their followers and a creative solution- and implementation-oriented mindset (Dewhurst and Willmott, 2014). They identify two challenges in their article: first, to create data sets that are worthy of the most intelligent machines and their growing decision-making potential; second, managers have to "let go" in a way that runs counter to a century of organizational development (Dewhurst and Willmott, 2014). Unfortunately, their article lacks a derivation and scientific justification of the tasks and characteristics.

By describing general organizational, technological, and generational trends, Petrucci and Rivera (2018) propose an answer to how a future' digital leader' should act. According to them, a future leader should foster collaboration and innovation by bringing together vertically integrated, cross-functional teams. This creates an agile way of working by ensuring continuous communication with and empowerment of team members.

Based on the thinking of Cascio and Montealegre (2016), Cortellazzo et al. (2019) think that tools like machine learning, Big-Data and AI are quickly becoming as infrastructural as electricity. They see top management as enablers of these new technologies and describe which characteristics might be necessary to handle them (Cortellazzo et al., 2019). Starting with coaching abilities to enable employees and communications skills, an executive should

be IT literate, creative and adaptable. Finally, a manager in the era of AI should be able to adapt to unique circumstances and be ready to innovate and respond to opportunities and threats as they appear (Chamorro-Premuzic et al., 2018).

With a broader focus on digital transformation through new information and communication technologies (ICT), Gonciarski and Switkowaski (2018) see a substantial impact on the work of managers. Their article describes the necessary skills of a so-called "digital manager." Inspired by Reyre and Lippa (2015), Gonciarski and Switkowaski (2018) state that digital managers should be aware of their team members, develop recursive thinking to promote creativity, act as visionaries in an agile way, and empower their team members to make full use of their potential. They conclude that the role of a manager in the past was only in monitoring structures; in the digital age, it must be much more and include being present and listening.

Pfeifer et al. (2022) describe the impact of artificial intelligence (AI) on the qualifications and competencies of leaders. AI's autonomous decision-making abilities are highlighted as a driving force behind this transformation. They indicate that as AI gradually assumes specific tasks previously handled by human leaders, it will lead to a redistribution of responsibilities. This shift in leadership roles will necessitate changes in the skills and knowledge expected of leaders. They identified four key competency categories: 1) Professional Competencies: Leaders are not required to be technical experts in AI but should have a basic understanding of its functioning. Their focus should be on assessing data quality and its relevance. 2) Methodological Competencies: Leaders must be proficient in designing and managing the complex process of organizational change, especially in AI integration. 3) Personal Competencies: Leaders should be able to effectively navigate the changes AI brings to the organization. 4) Social competencies: Leaders should facilitate interactions between employees and AI. They must consider both parties' unique characteristics and actively shape their dynamics. This transformation is not limited to technical knowledge but encompasses data assessment, change management, personal skills, and social abilities. Leaders are encouraged to involve employees in designing their roles relative to AI and ensure everyone understands their significance within the organization's evolving processes (Pfeifer et al., 2022).

Gilli et al. (2023) highlight three essential skills for managing digital transformation. First, they describe effective Leadership Skills. Leaders must exert influence on their teams, ensure strategic alignment, generate ideas, and address individual performance differences and conflicts, even in remote working conditions. Transparent performance evaluation and remuneration models, as well as providing resources and empowerment to make decisions independently, are critical aspects of effective leadership in digital transformation. Second, they emphasize strong Change Management Skills. Leaders must have strong change management skills to actively shape digital change processes. They should maintain an open attitude toward change, be open to innovations, and make quick decisions to respond to new trends. Leaders are also expected to inspire employees, reduce fears related to change, and convey the purpose behind the changes, fostering a sense of meaning within the team. Third, they identify Conceptual Digitization Skills. Leaders and executives should possess conceptual digitization skills rather than in-depth technological expertise. These skills involve a mindset focused on holistic thinking, recognizing correlations, and making appropriate decisions. Leaders are also called upon to reflect on a meta-level, mainly when dealing with big data, to ensure ethical and secure data handling in the digital transformation (Gilli et al., 2023).

In their qualitative phenomenological study, Sejera and Bocarnea (2022) answered the question of which leadership attributes are desired in the management of AI Technology. In summary, a manager responsible for overseeing AI technology within an organization should be knowledgeable about organizational alignment, path-goal leadership theory, expectation

symmetry, entrepreneurial leadership, effective communication, and the establishment of efficient incentive systems. These attributes collectively contribute to the effective management and integration of AI technology into the organization's operations (Sejera and Bocarnea, 2022).

In today's fast-paced and ever-changing business landscape, effective leadership demands a comprehensive approach encompassing various critical aspects (Bersin, 2018). Considering the rapid evolution in business and technology, leaders must exhibit remarkable adaptability. They should be open to embracing novel business models and agile enough to navigate the industry's shifting tides. A profound understanding of digital technologies is a fundamental prerequisite for leaders. Digital leaders distinguish themselves by forming small, highly empowered teams and entrusting them with significant responsibilities. They instill a culture that promotes autonomy while holding these teams accountable for delivering meaningful customer impact. Influential leaders foster a culture of experimentation within their organizations. They encourage team members to initiate projects on a small scale, iterate rapidly, and adapt to changing circumstances. This approach encourages innovation and agility. Leaders should champion using real-time information systems that facilitate data-driven decision-making at all organizational levels. This empowers teams to make informed choices and respond promptly to emerging opportunities and challenges. Leaders adopt a holistic perspective, viewing their organization as a platform rather than merely a provider of products and services. They actively seek individuals with entrepreneurial backgrounds, allowing them to innovate and design programs that align with their vision. This entrepreneurial spirit fuels innovation within the organization. Influential leaders place a premium on open communication within the organization and depart from traditional hierarchical structures; leaders champion a "network of teams" approach in which geographic units function as independent resellers. Bersin (2018) also states that leaders are responsible for instilling an innovation-focused mindset within the organization. They drive a culture of scalability by implementing standardized platforms, ensuring the organization remains agile and prepared for the future (Bersin, 2018).

AI leadership requires managers to develop key skills in three areas: ethos, mindsets, and culture. AI ethos emphasizes a responsible approach to AI, addressing ethical, legal, and societal implications while ensuring the trustworthy and balanced use of AI technologies. AI mindsets focus on rethinking workplace operations, committing to ethical AI development, and preparing employees for human-AI collaboration. AI culture involves fostering an environment that values AI, testing its applications, and balancing tasks between human and AI collaboration. These competencies enable managers to drive ethical and effective AI adoption in their organizations (Du et al. 2023).

Drawing insights from an empirical study encompassing eight Finnish service sector organizations, Larjovuori et al. (2018) identified four primary dimensions encapsulating leadership's role in digital business transformation. Starting with strategic vision and action, leaders are central in formulating and executing a strategic vision that guides the organization's digital transformation efforts. Their role involves setting clear goals and taking decisive actions to steer the organization toward digital maturity. Effectively navigating digital transformation necessitates leaders who can lead cultural change within the organization. They must instill a digital mindset, fostering a culture that embraces change, innovation, and digital adoption. This involves providing the necessary resources, technology, and support to facilitate a seamless transition to digital business practices. In the digital era, leaders must extend their influence beyond the organization's boundaries by building and leading networks. Collaborative partnerships and alliances are crucial, and leaders are at the forefront of forging these connections to enhance the organization's digital capabilities (Larjovuori et al., 2018).

Sposato (2024) describes how managers in AI-driven environments must understand emerging technologies, their business applications, and industry implications, supported by hands-on experiences like workshops and seminars. They require adaptive leadership skills, including agility, innovation, and decision-making in AI-induced scenarios. Ethical awareness is crucial, with a focus on addressing AI-related dilemmas like bias, data privacy, and societal impacts. Strategic implementation skills, such as evaluating readiness and aligning AI initiatives with corporate goals, are essential, alongside the ability to build and manage diverse, cross-functional teams. These competencies ensure that an organization's adoption of AI is effective, ethical, and innovative.

These findings enrich our understanding of leadership in digital business transformation and contribute to the broader body of research on leadership in digital business development.

4.3 Findings of the meta-analysis

This chapter analyzed patterns between authors, countries of publication, research techniques, publication aims, industries investigated in the documents reviewed. For this analysis, all relevant sources—primary and secondary—were used. Relationships resulting from the coding, such as the frequency of the codes in the references and the context in which the coded words were used, are described. Out of the 730 search results, only fifteen articles defined as primary sources were relevant for inclusion in the pre-study. Most of the sources found are practice-oriented business literature with no scientific methodology and a practice-oriented target group in the middle and top management.

Challenges in conducting the meta-analysis included the prevalence of methodologically weak studies, which limited the overall reliability and robustness of the findings. Another significant issue was "data recycling," where multiple studies drew from the same datasets and sources, leading to redundancy and a potential overrepresentation of certain data in the analysis. This overlap made it difficult to ensure the findings' independence and introduced the risk of inflated effect sizes or biased conclusions. The process of synthesizing consistent and meaningful results across the body of research was further complicated by variations in study design, sample size, and measurement tools.

The sources with a scientific background use predominantly a qualitative method and not many are based on empirical studies. Most authors either have a university background or work for a consulting firm. The authors with a university background mainly work at business schools in whose name they publish. The authors with a consulting background often advertise their "solutions" and do not use any scientific methods to support their recommendations. As Table 3 illustrates, six of the 17 identified articles were published in business magazines. The eleven other articles were published as scientific papers in magazines, while another three were published as conference papers.

A large part of the literature comes from the health and medical sectors, where the use of new technologies in medicine is discussed. Many articles described what chief physicians and medical staff need to consider when working effectively with new technologies. However, concrete examples are not provided. Strikingly, the reports include a lot of information about the telecommunications industry in addition to the medical industry. Many of these papers come from Asia. Additionally, most of the literature comes from leading authors in the development of AI (China and the USA).

While digital skills enable managers to effectively work in a tech-enabled environment, artificial skills are specialized competencies that involve understanding and collaborating with AI systems to enhance strategic and operational decision-making. Both skillsets complement each other but operate at different levels of technological sophistication.

Table 3. Articles by research design and methodology

Sources		Research design	No. of articles	Research method	
Business magazines	*6*	Qualitative	7	Interviews	2
				Case studies	1
				Literature research	4
				Other	
		Quantitative	4	Experiments	1
Scientific magazines	*11*			Surveys	1
				Meta-analyses	2
				Text analyses	
				Other	
		Mixed method			0
		No method			6
Total	*17*	*Total*			*17*

Source: Authors' own creation

None of the sources analyzed distinguished between "digital leadership skills" and "artificial leadership skills" in the manner Kollmann et al. (2023) did. While digital skills enable managers to work effectively in a tech-enabled environment, artificial skills are specialized competencies that involve understanding and collaborating with AI systems to enhance strategic and operational decision-making. Both skillsets complement each other; however, they operate at different levels of technological sophistication.

In addition, these sources did not distinguish between "leadership" and "management." Zalezink (1977) was the first economic theorist to differentiate between manager type and natural leadership. In his opinion, whether someone manages or truly leads depends on their personality structure. With his article, Zalezink (1977) paved the way for John P. Kotter, whose central understanding of management is that a manager's role includes management (e.g., decision-making and coping with complexity) and leadership (e.g., dealing with change, motivating, and inspiring) tasks (Kotter, 1990). To define management and leadership more concretely, Day's (2001) analogy can be used. He describes leadership "as processes which generally enable groups of people to work together in meaningful ways, whereas management processes are considered to be position- and organisation-specific" (Day, 2001, p. 582). Many management functions are consistent with the definition of leadership (Northouse, 2015). Bennis and Nanus (2003) demonstrate that there are significant differences between management and leadership. They made this differentiation very clear in the frequently quoted sentence), "Managers are people who do things right, and leaders are people who do the right things" (Bennis and Nanus, 2003, p. 221).

Moreover, no authors distinguish between tasks, skills, or even personality traits that managers should have. None of the coded articles has a description for the management or describes a target group in the management level, for example, C-Level or Middle Management. Likewise, no distinction is made for a specific industry and in areas where a manager can work, such as administrative or productive areas.

5. Implications and conclusions

5.1 Implications

Sposato (2025) emphasizes that leaders in AI-driven research environments must develop core digital skills like technological proficiency, data literacy, and innovation management while fostering ethical AI practices to address issues like bias, privacy, and inclusivity. He

highlights the importance of creating a supportive organizational culture that encourages experimentation, interdisciplinary collaboration, and continuous learning. Practical strategies include phased AI implementation, investing in AI-ready infrastructure, and using clear metrics to evaluate progress while addressing resistance to change and skill gaps. Ultimately, leaders must balance technological possibilities with ethical considerations to drive innovation and advance human creativity and discovery. There is a real need to advance professional practice to help managers better support employees in the era of AI. This is particularly important as the leader's role becomes increasingly people-oriented (Huang et al., 2019). To sidestep debates on leadership legitimacy in the AI era, leaders must collaborate with technology (Jarrahi, 2018). Embracing the challenges of new technology promptly offers significant benefits for managers and organizations (Jones, 2018)

5.2 Conclusions

This study aimed to identify how AI changes effective managers' skills and personality traits based on a literature review. Skilled and capable leadership could be a competitive advantage for companies in the era of AI. To adapt effectively to AI, leaders should focus on developing communication skills and forming high-performance teams working cross-functionally (Petrucci and Rivera, 2018) and in a symbiosis of humans and machines (Jarrahi, 2018).

In a world where algorithms analyze mountains of data in milliseconds and automation handles routine tasks with unparalleled efficiency, the future of management belongs to those who can harness the potential of AI while preserving the essence of human leadership. The managers of tomorrow must blend their traditional skill sets with a new proficiency in understanding, leveraging, and governing AI. As the business landscape evolves, so must the capabilities of those who guide it.

Organizations' handling of AI driven changes is a competitive strategic advantage (c.f. Haefner *et al*, 2021; Sasmoko et al. (2019). AI significantly enhances leadership by enabling data-driven decision-making, strategic planning, and resource optimization. Leaders can leverage predictive analytics to identify market trends and customer behavior, allowing for more effective strategy execution (Al-Bayed *et al*, 2024). Additionally, AI automates routine tasks and provides real-time performance insights, freeing up human resources for higher-level strategic activities. Ultimately, these applications foster innovation and adaptability, helping organizations navigate complex business environments more successfully.

After reviewing the relevant literature on management and leadership tasks and decision-support systems from various perspectives, it remains unclear which aspects of tasks and competencies are relevant for leaders in the era of AI. Therefore, which competencies may help leaders interact with algorithm-based decision support systems is not sufficiently clear. Consequently, further research is needed to identify the factors that influence leaders when an organization is using these systems.

The concept of "artificial leadership" or "leadership with AI" remains in its early stages. Consequently, much of the initial discourse can be found not only in academic journals but also in anthology contributions and the first books addressing the topic. This body of literature is only partially included in the commonly used databases. The limitations of this study include the type of literature analyzed. The literature analyzed is mainly practice-oriented, and only in a few cases were scientific methods used. The exclusive use of secondary data and the associated quality of the sources can lead to research bias. On one hand, the advantage of using secondary sources is that they can be accessed without additional cost and without the need to invest in a survey. On the other hand, the sources were collected for different purposes and to answer further questions, which could lead to bias. To avoid biases caused by secondary sources, primary data should be collected (Saunders et al., 2016). The study is also limited to works

indexed in the Scopus, EBSCO Business Source Complete and Web of Science databases. Furthermore, the search protocol focused specific keywords and had a selection criterion which could lead to bias. Only articles up to November 2024 were included, though new publications have appeared recently. Therefore, incorporating new articles could enrich the findings. Such scientific studies are needed to establish the impact of AI on the necessary skills and personality traits of managers and leaders.

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Further reading

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