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Artificial Intelligence and the evolution of managerial skills:
An exploratory study

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Abstract. This article investigates how the rise of Artificial Intelligence (AI) in organizations may affect managerial skills. We conducted qualitative and semi-structured interviews of 40 experts around the world who work with AI in a variety of disciplines and sectors. Using thematic content analysis on the data, we identify the trends showing how AI may replace, augment, or not affect managerial skills. In addition, our results highlight the technical and non-technical skills that managers should develop for successful implementation of AI. This study contributes to the scholarship in its depiction of these trends and in its empirical exploration of the links between managerial skills and AI. We also supplement existing taxonomies of managerial skills, provide future research proposals, and discuss the theoretical as well as the practical implications of our study.

Keywords: Artificial Intelligence, AI-HRM interface, managers.

1. Introduction

Artificial Intelligence (AI) is 'a system's ability to interpret external data correctly, to learn from such data, and to use those learnings to achieve specific goals and tasks through flexible adaptation' [1]. AI technology turns out to be essential for the success of many organizations [2] and one of the most disruptive technologies of the 21st century [3]. It has facilitated a fourth industrial revolution [4] and continues to rapidly develop [5]. Between 1991 and 2015, AI patents increased by 11% each year [6].

As AI is likely to alter the future of work design [7], managerial skills are facing a possible upheaval by being replaced, extended, and even remodeled. However, theoretical [8] and empirical [9] elements on that matter are still lacking. Although Huang and Rust [10] have written that the rise of AI in organizations may replace some managerial skills, their research did not focus on managers. While Huang *et al.* [11] have suggested that 'managers must adapt the nature of jobs to compensate for the fact that many of the analytical and thinking tasks are increasingly being performed by AI', their analysis was performed at the macro-level and based on secondary data. To our knowledge, the literature only offers scattered elements about the interplay between AI and skills with regard to the *managerial* category. No empirical study has yet been conducted to specifically assess the impact of AI on managerial skills.

In the next section, we review the academic literature on managerial skills in relation to AI. We then outline the exploratory and qualitative methodology of our empirical study. We next present and discuss the results of our study. Before concluding our study, we suggest paths for future research.

2. Literature review

2.1 Managerial skills

Over time, managerial skills have been categorized in multiple ways. Fayol [12] first classified managerial competencies as related to planning, organizing, commanding, coordinating, and controlling. Mintzberg [13] later identified managerial skills as interpersonal, informational, and decisional. In parallel, Katz [14] proposed an alternative set of three critical managerial skills: technical, human, and conceptual. Similarly, Bhanugopan *et al.* [15] listed personal attributes, managerial skills, and business skills. Robbins and Coulter [16] added that due to rapid globalization, competition, and the pace of technology, managers face other integrative issues, such as managing in a global environment, diversity, social responsibility, change, and innovation.

2.2 Artificial Intelligence

Farrow [17] has defined AI as 'a computer science aiming to perform tasks that replicate human or animal intelligence and behavior'. This technology includes

machine learning, robotics, computer vision, automated reasoning, machine perception, and knowledge representation [18–20].

2.3 Relationship between AI and managerial skills

As AI changes the nature of work and collaboration [7], it interacts with managerial skills. Nevertheless, theoretical [8] as well as empirical [9] elements are lacking and remain dispersed in the literature. In this section, we discuss how AI is likely to overtake or augment certain managerial skills, and which managerial skills are necessary for successfully implementing AI.

In fact, the current literature anticipates three major kinds of impacts of AI on jobs, tasks, and skills: the latter can be *replaced*, *augmented*, or remain *unaffected* [17,21,22]. While this technology could in fact *replace* some skills and even jobs (often associated with repetitive and simple tasks), AI would also be capable of *augmenting* human tasks that remain too complex to be replaced by a machine. An optimized managerial decision or specific skill could then be based on an automated AI pre-analysis. This *augmented* output would be reached thanks to an optimized collaboration with the machine which could take the form of a hybridization of managers [23], potentially through symbiotic metamorphosis [24]. Finally, some skills might neither be *replaced* nor *augmented* because of their extreme complexity or their strong human nature: like emotional intelligence, for instance (Mattingly & Kraiger, 2019). Those very skills would therefore remain *unaffected* by AI, at least in the form in which this technology exists today.

The literature also suggests that introduction of AI into organizations triggers the need for specific, or even new, managerial skills. Emergent AI is already able to automatically generate initial production system configurations [25] and to optimize production [26]. If AI can make predictions in an abundant and inexpensive way, then managers need to decide how to best implement such predictions, which will involve using their judgment. This judgment comes from knowledge of organizational history [27], a dimension that AI usually fails to consider and which should be monitored by humans. So far, AI looks unable to show advanced ethical judgment, emotional intelligence, artistic taste, or ability to define tasks well [28].

3. Empirical study

3.1 Data collection

Qualitative research design and semi-structured interviews. We follow Yin's [29] argument that the 'how' questions should be addressed through qualitative research methods. Particularly, this study uses grounded theory—specifically Interpretive Grounded Theory (IGT)—because it allows new theory creation [30] about new phenomena, which can explain in conceptual terms what is actually going on in the field [31]. IGT served our needs because we were engaged in interpreting the data and extracting information from the literature before and during the data analysis. Secondly, this approach is consistent with the methodology used, as open-coding, axial-coding, and dimensions creation go hand-by-hand with IGT. Thirdly, the ultimate goal of theory development is in line with IGT.

Therefore, our study design draws upon semi-structured interviews with experts who work on AI in a variety of sectors and countries. Semi-structured interviews are the most commonly used designs in qualitative research [32]. As Bell *et al.* [32] recommended, we used an interview guide. Qualitative interviews focus on the interviewee's point of view rather than on the researcher's concerns, with the objective of obtaining rich and detailed answers. This approach sometimes requires flexibility in ordering questions and even openness to adding new questions based on respondents' replies [32]. Interviewing respondents is a structured and common way to collect data on respondents' experiences and perspectives [33,34].

Data were collected in the summer of 2019, after and during a time of rapid AI development [35]. Two researchers from our team led face-to-face interviews in English. Each interview lasted approximately an hour and was audio-recorded (with the permission of the participants), and then transcribed. To increase the credibility of our qualitative research, a validation process was conducted by sending a summary of the findings to each participant to seek corroboration of interpretations of the interview responses [32]. We sent summaries, rather than entire scientific documents, to avoid difficulties in terms of participants understanding theories, concepts, and contextual issues [36]. To guarantee dependability (reliability), we kept complete records of all phases in the research process, including the participant selection, fieldwork notes, interview transcripts, and data analysis, in case further verification and justification were needed [32].

Sampling

The sampling of a variety of management levels, sectors, and countries should increase the transferability and dependability of our results [37]. In sum, our sample includes 40 participants from 30 companies and seven industries (research, consulting, automotive, education, aerospace, energy, and utilities). The sample is composed of 22.5% women and 77.5% men, which is representative of the current population of AI specialists in terms of gender[1]. The average age is 42 years, with four years of job tenure. External reliability is difficult to acquire in qualitative research (LeCompte & Goetz, 1982), but we attempted to increase external reliability and external validity by using a variety of management levels, sectors, and countries.

Data analysis

We used the NVivo 12 software, a common tool in business research [32], which allows thematic content analysis of a full transcript of interviews, as recommended by Roulston [39]. This method of analysis is the most common in organizations and best suited to these kind of data [40]. To improve internal reliability, each researcher simultaneously interpreted and analyzed the data before proceeding to comparison [32].

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[1] https://reports.weforum.org/global-gender-gap-report-2018/assessing-gender-gaps-in-artificial-intelligence/

4. Results and Discussion

Our study aimed to answer calls from scholars regarding further investigation of the links between AI and skills [8,41–43] with empirical elements [9] and regarding the future of work [7]. Fig. 1 summarizes our findings. The collected data has allowed us to identify the most plausible upcoming trends about the interplays between AI and managerial skills. Two major trends (in grey in Fig. 1) have indeed been shared and expressed by most of our respondents and are likely to significantly impact organizations: First, AI is likely to augment most managerial skills; Second, technical and non-technical managerial skills will probably have to be developed in order to optimize the use of AI in organizations.

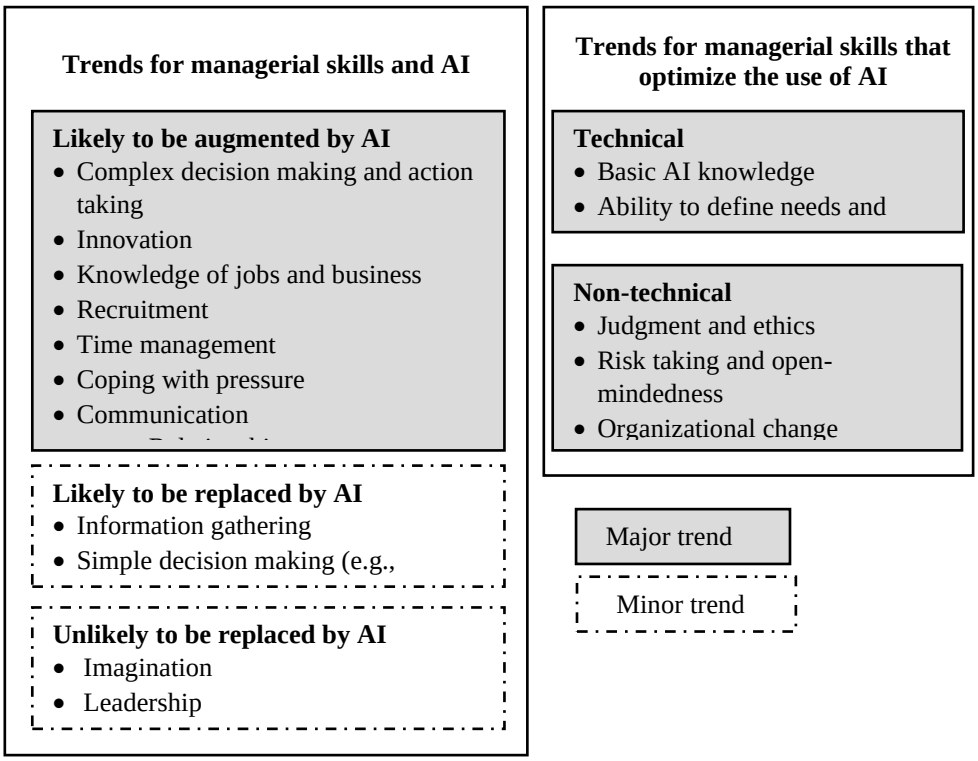

Fig. 1. Minor and major trends about the relationships between Artificial Intelligence (AI) and managerial skills

Our results first show which managerial skills are likely to be *replaced*, *augmented*, or *remain unaffected*, confirming the relevance of those categories when it comes to qualify the effects of AI on jobs, tasks, and skills [17,21,22]. In a recent article, Raisch and Krakowski [44] argue for a change of perspective on these categories as, in the management domain, *augmentation* cannot be neatly separated from *automation*.

4.1 Minor trends about the relationships between AI and managerial skills.

As highlighted in Fig. 1, two minor trends first appear in our results: only a few managerial skills are likely to be (1) fully replaced or (2) unaffected by AI.

Managerial skills likely to be replaced by AI. Because managerial jobs are complex, involving analysis, solving advanced operational problems, and human relations, the sampled experts confirm that few managerial skills are eligible for wholesale replacement by AI [11]. Our respondents recall that AI has already replaced managers for information provision and simple decision making [45]. This finding is consistent with the work of Lichtenthaler [46], who has categorized automation jobs involving limited complexity as a 'substitute' matrix that replaces human work with increased efficiency. Therefore, AI may increase managers' opportunities to focus on work requiring their core competencies in order to better participate in value creation [25], even though our respondents add that some specific managerial skills will then be needed for successful AI implementation (see *Managerial skills that optimize the use of AI* in section 0, below).

Managerial skills unlikely to be replaced by AI. Our respondents add that AI might never replace advanced managerial skills such as imagination and leadership. Imagination, including such tasks as thinking of questions to ask and imagining something that does not yet exist, may indeed not be replicable by AI [47]. Agrawal *et al.* [28] have also noted that AI is not creative enough to find new opportunities by itself. In that sense, we can confirm that storytelling and motivational speeches are unlikely to be duplicated by AI [46,48]. The interviewed experts also indicate that AI may be unable to lead because of the inherent difficulty it has to generate ideas *ex nihilo* and dealing with employees' trust or emotions [49]. Leading should remain a core managerial and human competency unaffected by AI, consistent with previous findings [28,50].

4.2 Major trends about the relationships between AI and managerial skills

In contrast, our respondents indicate two major trends about the relationships between AI and managerial skills: (1) a majority of managerial skills are likely to be augmented by AI while (2) specific, and maybe new, managerial skills may be needed to optimize the use of AI in companies.

Managerial skills likely to be augmented by AI. Our respondents agree that managerial skills to be augmented by AI actually cover a large spectrum from planning, organizing, and controlling [12,16], to self-insight roles like self-management and self-development [51] and through creativity. Another example yielded by our data is that AI could produce abundant and inexpensive predictions to enable managers to better know their jobs and business, which completes the work by Agrawal *et al.* [28]. Our results additionally suggest that prediction can help for the identification of talents [52]. Even if our data confirm that AI may not conduct a full recruitment process autonomously, they suggest that its applications for hiring and selecting can be useful, even though the literature recalls that contextual factors should be carefully considered [53]. Our respondents confirm how AI can continue

to augment managers for time, project management, and even stress management (i.e., Egger & Kleiner, 1992; Javanmardi *et al.*, 2014). The technology can indeed process information (Brynjolfsson *et al.*, 2018) that provides managers with more control, therefore reducing stress (Lambert *et al.*, 2003) in adverse situations. AI may also augment managerial skills for communication through enhanced (1) relationships, as already suggested by Sumi and Nishida [58], with the provision of valuable background information about individuals, and (2) translation. Due to rapid globalization, managers face integrative issues such as managing multilingual and multicultural teams [16] which might provoke communication issues caused by language differences where AI could be particularly helpful.

Our results provide specific clues about how managerial practices are likely to be enhanced by AI in the coming years [59]. The anticipated augmentation of most managerial skills is a significant contribution to the AI-HRM literature, which must anticipate how the interplay between AI and humans should be framed and supervised. This observation supports the hypothesis that managers may have to radically adapt to AI [60] and strive towards hybridization [23], possibly through symbiotic metamorphosis [24].

Managerial skills that optimize the use of AI A second major trend highlighted in our data suggests that managerial skills may need to be developed to optimize the implementation and use of AI. These skills should be technical as well as non-technical. If the literature has previously investigated the topic from a macro point of view [11], our results provide specific elements about the managerial occupations.

Our data suggest that managers should at first acquire technical skills like basic AI knowledge as well as the ability to define when and how AI could be helpful for their activity. Our results confirm that managers play a key role in identifying the rationale for using AI [61], analyzing business cases [62], weighing costs and benefits as well as spotting any misleading conclusions that could be produced by AI applications [63].

Moreover, managers are invited to own non-technical managerial skills in order to optimize AI implementation. According to our respondents, a good AI prediction remains subject to a good managerial judgment. This finding is consistent with the literature stating that AI usually lacks good judgment [28] and that managerial training may shift from focusing on prediction-related skills to judgment-related skills [64]. Thus, final decisions related to critical and ethical issues are unlikely to be replaced and should be handled by humans. We confirm that future managerial skills are likely to be about determining how to best apply AI to making predictions and what should be predicted [28]. Our respondents also reiterate the necessity for managers to maintain a clear sense of ethics to prevent AI bias and misuse [65,66].

Additionally, our results suggest that managers need to be open-minded and keener on taking risks: although AI remains costly, this technology does not always yield immediate results as it often requires learning and adjustment. Building and maintaining trust with a risky tool therefore seems to be a priority [68]. Therefore, our results confirm that organizational change management skills could facilitate commitment to AI [69] and reduce resistance to new technologies [70]. These non-technical skills are important skills, as AI may be seen as a threat to some

occupations and can trigger significant fears [71] as well as unrealistic expectations [72].

Our results corroborate that managers must develop the necessary skills to define new job descriptions and organizational structures required by AI [73]. This technology will probably produce a stronger multidisciplinary collaboration. Our experts agree that clear role descriptions and task separation may be needed in order to grant an effective AI-HRM interface as humans team up with machines [74]. Our respondents also confirm that AI may radically change power relationships [23,75]. In fact, knowing that technical changes are occurring at a fast pace [75], our respondents confirm that the development of organizational learning appears to be a prerequisite for a successful AI implementation [76].

Overall, our respondents verify that the success of AI requires preliminary socialization [24]. Thus, our results suggest that managers may be in charge of dealing with AI-induced changes, including power reconfigurations [75]. From that perspective, non-technical skills such as organizational change management and multidisciplinary collaboration appear necessary to cope with AI implementation. Our research therefore confirms that companies adopting AI should further consider the relational and structural complexities associated with the implementation of such advanced technology [24].

Our results confirm that with the advent of AI, managers 'will need to be more skilled than ever before' [59]. Our study even implies that the existing taxonomies of managerial skills (e.g., Gentry *et al.*, 2008) should be updated and re-prioritized so that an effective AI-HRM interface can be set up [77]. Our results show that AI might increase managers' opportunities to focus on work requiring their core competencies in order to better participate to value creation [25]. They also warn that the right conditions must be met (i.e., managers having the appropriate skills to implement AI). For example, they recall that human decision making based on AI will likely require managers to acquire new skills, as the literature has already claimed about other occupations [78].

5. Conclusion

Our results reveal major and minor trends about the managerial skills that are likely to be replaced, augmented, or unaffected by AI and how such changes might occur. Further, our data evince specific technical and non-technical skills that managers are expected to develop to successfully accommodate the growing presence of AI.

5.1 Limitations

A major limitation of our study is the heterogeneity of our sample in terms of selected locations, occupations, and sectors. Because access to AI experts was challenging, we thought it was more important to produce rich accounts of experts' experiences, a technique known as 'thick description' [79], thereby providing other researchers with a useful database for assessing the possible transferability of findings to other contexts [80]. The diversity of our respondents finally turns out to be an interesting way to undertake a comprehensive exploration of a globally rising

phenomenon like the introduction of AI into corporations and its impacts on managerial skills at the AI-HRM interface [81].

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