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UNDERSTANDING HUMAN-AI AUGMENTATION IN BUSINESS AND MANAGEMENT CONTEXT: A LITERATURE REVIEW

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Research Paper

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Abstract

The relationship between human and artificial intelligence has attracted debates and polarized views. A key area of this debate that received research attention is human and AI capability to augment each other to achieve better outcomes. While there is a growing research interest in the topic, research is currently dispersed and spread across the management disciplines making it hard for researchers to benefit from an accumulated knowledge in this domain. This study synthesizes the literature and describes the current research findings in order to provide foundation for future research in this area. Based on a systematic review, we identify and discuss three emerging themes in the literature and highlight different possible challenges related to integrating AI in organisations. A future research agenda is also presented.

Key words: Artificial Intelligence, AI, Human-AI augmentation, Human-AI collaboration, Human-AI symbiosis.

1. Introduction

The first introduction of Artificial Intelligence (AI) was in 1956 by John McCarthy at a Dartmouth conference (McCarthy et al., 1956). AI was introduced as "making a machine behave in ways that would be called intelligent if a human were so behaving"(McCarthy et al., 1955, p. 11). AI technology refers to the capacity of machines to perform tasks that ordinarily require human intelligence (HI) (Allen, 2020). It includes a range of technology such as natural language processing, machine vision, robotics underpinned by different machine learning techniques (Gkinko and Elbanna, 2022). The adoption of AI has become ubiquitous in business (Park et al., 2021) due to the existence of big data and the advancement in computer power (Haenlein and Kaplan, 2019, Wamba-Taguimdje et al., 2020) combined with organisational needs to improve their agility, efficiency and quality of performance in today's highly volatile market environment (Basri, 2020, Buntak et al., 2021).

However, there is a heated debate on AI use in organisations and its capability to replace the need for HI and humans in most professions. This debate invited several calls for researchers to focus on examining the relationship between AI and humans in organisations. For example, Van Veldhoven and Vanthienen (2022) called for shifting the focus from solely considering the AI technology to paying attention to the interactive relationship between humans and machines. Scholars argue that it is not necessary that this interaction means the complete replacement of human in organisational applications and this interaction could take the form of different degrees and types of automation and augmentation (Brynjolfsson and McAfee, 2014, Wilson and Daugherty, 2018, Davenport and Kirby, 2016, Johnson et al., 2022, Xue et al., 2022). *Automation* refers to machines taking over to substitute humans in completely performing the tasks traditionally conducted by humans in the workplace and process these tasks without the need of any human involvement. *Augmentation* refers to the possibility of developing a complementary and collaborative relationship between humans and machines that benefit from each other's strengths in order to achieve optimal productivity for various organisational tasks (Raisch and Krakowski, 2021b, Amershi et al., 2014, Rahwan et al., 2019). Other terms, which are used to name a human receiving the machine augmentation, are "cyborg" (Grewal et al., 2020) and for a machine

receiving a human support as "human-in-the-loop" (Metcalf et al., 2019, Gronsund and Aanestad, 2020, Siemon, 2022).

Although Raisch and Krakowski (2021b) suggested that there is an inherent tension between automation and augmentation for an organisation, Xue et al. (2022) proposed that automation and augmentation are complementary and can coexist without triggering any conflict while Einola and Khreva (2023, p.117) empirically find that automation and augmentation "may not be detached from nor exist in tension with each other". The decision to choose either automation, augmentation or variations of both would be based on the nature of the tasks and organisational strategy (Tegmark, 2018). Scholars argue that AI surpasses humans in some certain facets of work such as uncovering patterns in large datasets and in data management yet humans can achieve high level of agility in decision making (Teodorescu et al., 2021a). Since some of the managerial activities in an organisation constitute high-complexity task and require the flexibility for each situation, an organisation might achieve the highest level of efficiency with the intervention of both humans and machines (Holzinger, 2016). In that same vein, other scholars argue that machines can complement and augment humans in doing tasks rather than completely substitute them in the workplace (Raisch and Krakowski, 2021b). The combination of humans and machines generates substantial improvement of work performance (Fuegener et al., 2022, Raisch and Krakowski, 2021b, Wilson and Daugherty, 2018) and could bring more effectiveness compared to each one's perform separately (Loske and Klumpp, 2021). For example, in customer service, studies find that machines can free humans from basic and repetitive activities and facilitates humans focus on high-level tasks, which yields more value for an organisation (Huang et al., 2019, Spring et al., 2022). In healthcare, scholars find that the involvement of machines might decrease the uncertainty of diagnosis process with its ability to scan, analyse and interpret patient x-ray images (Lebovitz et al., 2022a, Jussupow et al., 2021a).

A growing body of research has examined AI applications in different sectors and the nature, types and possibility of augmentation, however this research is scattered across management disciplines and in need of collation and organisation. This is in order to inform future research on what is known on this area and where research efforts might be best directed. Therefore, this study aims to answer the following questions:

(1) What are the themes on Human-AI augmentation in business that have been examined to date by researchers?

(2) What are the challenges researchers uncovered of Human-AI augmentation?

To answer the research questions, we conduct a systematic literature review, which is an organised, explicit, exhaustive and replicable process for recognising, analysing and synthesising the current research in order to pave the way for future research (Fink, 2019). The study identifies three main themes in the existing literature on Human-AI augmentation and highlights different possible challenges related to the integration of AI in organisations. In doing so, the study contributes to advancing knowledge on the domain of AI-Human augmentation. The paper is organised into seven sections. Following the introduction, section two presents the research background. Section three explains the research methodology while section four presents the research findings. Section five provides discussion and future research agenda. Subsequently, the limitations of this study are discussed in section six while the final section presents the implications of the study.

2. Research background

AI technology provides an approach to mimic human doing, thinking and even feeling (Huang and Rust, 2018a, Nilsson, 1971). It has unlimited potential for improving human's life in a wide range of areas such as healthcare, education, employment, entertainment, safety and transportation (Stone et al., 2022, Rahwan et al., 2019). AI has the ability to take charge of several types of task including problem-solving, perception and decision-making (Rai et al., 2019, Androutsopoulou et al., 2019). Two main approaches of AI, which are also the two stages of AI development, are known as Handcrafted Knowledge System (HKS) and Machine Learning (ML) (Allen, 2020, Huang and Rust, 2022b). HKS is in charge of presenting human knowledge through a series of rule-based system, which is pretty useful as it is the collection of thousands of rule (Allen, 2020). For instance, Deep Blue – a chess playing AI,

defeated the world chess champion by the millions of computer code rules in 1997 (Allen, 2020). While rules of the HKS system are created by human, ML system develops its own rules based on historical input data. ML is a learning process of machines which is relatively similar to some aspects of human intelligence (HI) (Buntak et al., 2021).

The important role of AI technology for management has been recognised since the 1950s (Newell and Simon, 1956, Newell et al., 1959). However, due to the immaturity of technology capabilities during the 1960s, scholars assumed that machines could only serve the operational repetitive tasks, that prevented AI from being included in a more complex works related to managerial activities (Raisch and Krakowski, 2021c). Accordingly, AI technology was studied under computer science and operation research, while business and management research paid more attention to humans (Rahwan et al., 2019). During two decades after that, AI technology received a little attention from management researchers (Kellogg et al., 2020, Lindebaum et al., 2020). Today, due to the advancement of AI capabilities which shifted from processing a simple problem to more intricate one such as social presence or creativity (Amabile, 2019, Tegmark, 2018) in addition to the availability of big data and computing capabilities, organisations turn to AI seeking the realisation of AI benefits of significant improvement of productivity, efficiency and effectiveness.

AI technology is more autonomous than traditional enterprise systems, which turned the focus from considering its operation by humans to collaborating with them (Demir et al., 2020). Human-AI augmentation is the alliance of humans intelligence and machine intelligence to tackled a shared problem (Teodorescu et al., 2021a, Lebovitz et al., 2022a). To date, the topic of Human-AI augmentation continues to be surrounded by some ambiguity partially due to the different terms used to describe it (Fuegener et al., 2022, Makarius et al., 2020). Scholars named the collaborative relationship of humans and machines differently using terms such as Human-AI interaction (Bauer and Vocke, 2020), Human-AI partnership (Vassilakopoulou et al., 2022), Human-AI augmentation (Teodorescu et al., 2021a, Raisch and Krakowski, 2021b), Intelligence Augmented (Barile et al., 2021), Hybrid Intelligence (Dellermann et al., 2019), Human-AI constellation (Larson, 2010) and Artificial Swarm Intelligence (Metcalf et al., 2019). In a collaborative relationship, humans and machines learn from each other when they interact in workplace (Amershi et al., 2014).

There are several drivers that lead an organisation to integrate AI in their system such as the potential realisation of AI capabilities, the availability of big data, the enhancement of computer power (Wamba-Taguimdje et al., 2020, Haenlein and Kaplan, 2019) and the competitive pressure of market (Buntak et al., 2021, Basri, 2020). Human-AI augmentation has pervaded into different aspects of business and management such as customer service chatbot (Maragno et al., 2022, Schanke et al., 2021b), sales and marketing (Huang and Rust, 2022a), research and development (R&D) (Johnson et al., 2022), human resource management (HRM) (Arslan et al., 2021, Park et al., 2021) and logistics (Loske and Klumpp, 2021). In customer relation management, AI is adopted to automatically respond to customer basic requests and delegate the complex enquiries to humans (Vassilakopoulou et al., 2023). In sales and marketing, the superior analytical ability of AI is utilised for analysing customer data to forecast and create sales plans (Buntak et al., 2021). In human resource management, AI-based systems are adopted for talent acquisition (Marr, 2018).

Effective collaboration is defined as the transformation and integration process of one's knowledge into others' own knowledge (Carlile, 2004, Levina, 2005). Although there has been no common formula to create the best collaborative intelligence yet (Amabile, 2020, Makarius et al., 2020), scholars suggest that it can be enhanced by human's trust and benefit realisation toward AI (Chowdhury et al., 2022). Researchers also proposed that the compatibility between types of AI applications and levels of human involvement need to be takes into consideration (Russell Stuart and Norvig, 2009) as this collaboration will be more productive when machines and humans are appropriately interconnected (Schoemaker and Tetlock, 2017). The improvement in the quality of this relationship will directly contribute to the benefits and productivity gains in the organisations (Arslan et al., 2021).

3. Research Methodology

3.1 Literature search

The detail of searching method and criteria are illustrated in figure 1. This study reviewed academic work on Human-AI augmentation in business from 1990 to the early of 2023 from Web of Science database. The authors used the Web of Science database as the primary source for literature as it is the largest publishers' independent publication databases (Webster and Watson, 2002). These chosen keywords are "Human AI augmentation" and its synonyms. The search strings for this review is "Human AI augmentation OR Human AI collaboration OR Human AI symbiosis OR Human AI constellation OR Human AI partnership".

Initially, the search for these terms on the period from January 1990 to March 2023 has resulted in a total of 3649 articles. The authors reduced the search results by selecting publications that are only in the English language, peer-reviewed documents and in the business and management discipline. This resulted in the identification of 69 articles. The authors proceeded to scan the title and abstract of these articles and removed 34 articles, which are not relevant to the topic of this study. The remaining papers were 35. This is followed by a full-text scanning, a paper is considered suitable if the content was accessable and it answered the research questions of this study. There were five un-accessable papers that were excluded. Finally, the authors carried out reference backward search to enrich the review from other sources. The final result recorded 31 papers in total.

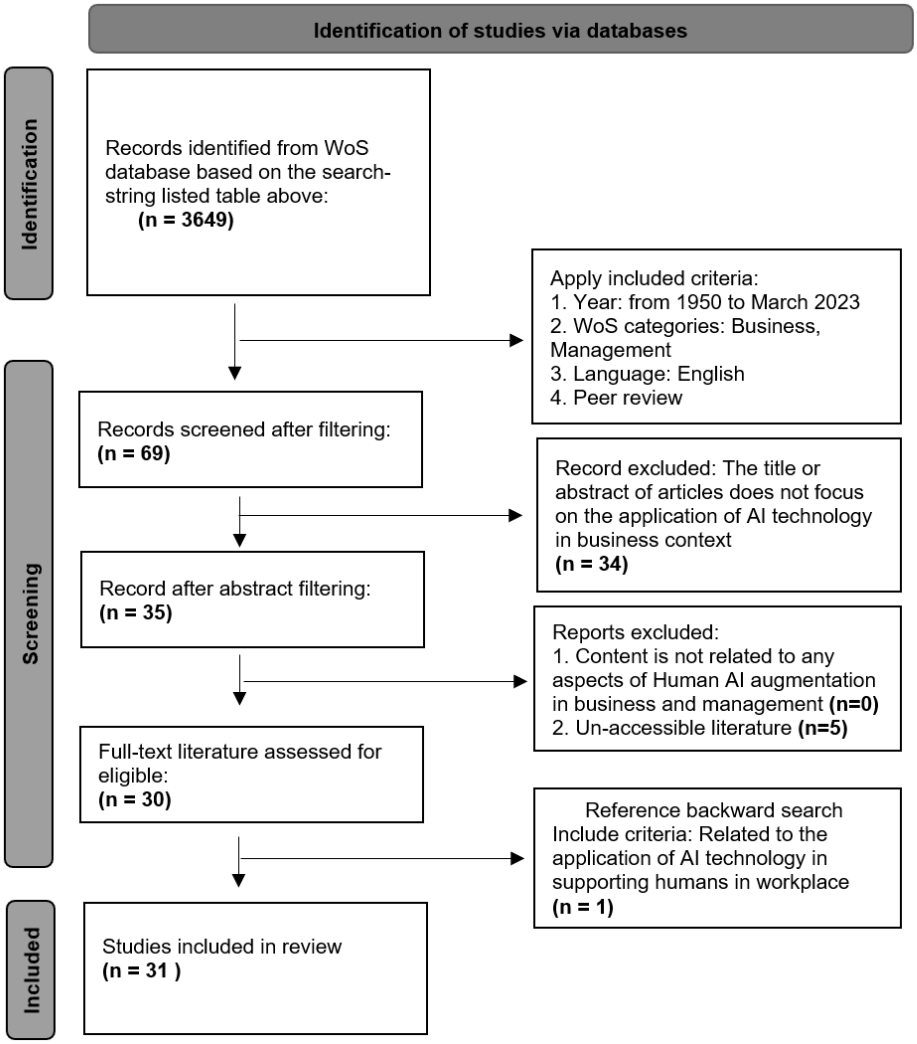

Figure 1. Search description.

3.2 Literature analysis

Thematic analysis was adopted to categorise the central themes and sub-themes in the literature (Liñán and Fayolle, 2015, Guest et al., 2011). Thematic analysis is considered one of the most prevalent and practical methods of qualitative approach (Guest et al., 2011) that is used to identify, analyse and report patterns within data (Braun and Clarke, 2006). The included articles were categorised into different themes (Appendix A).

Throughout the 31 chosen articles for this systematic review, seven topics were identified including (1) team up, team roles and task allocation, (2) automation versus augmentation, (3) human perception toward machines, (4) Human-AI augmentation work-related, (5) collaborative intelligence in decision making, (6) organisational reconfiguration, (7) general and domain-specific barriers (Appendix A). Among these topics, team up, team roles and task allocation received the highest attention from scholars discussed in 11 out of 31 articles, which accounts for over 35 percentage of the total chosen literature. Figure 2 illustrates the distribution of the seven identified topics on Human-AI augmentation in business. The findings section discusses them in details.

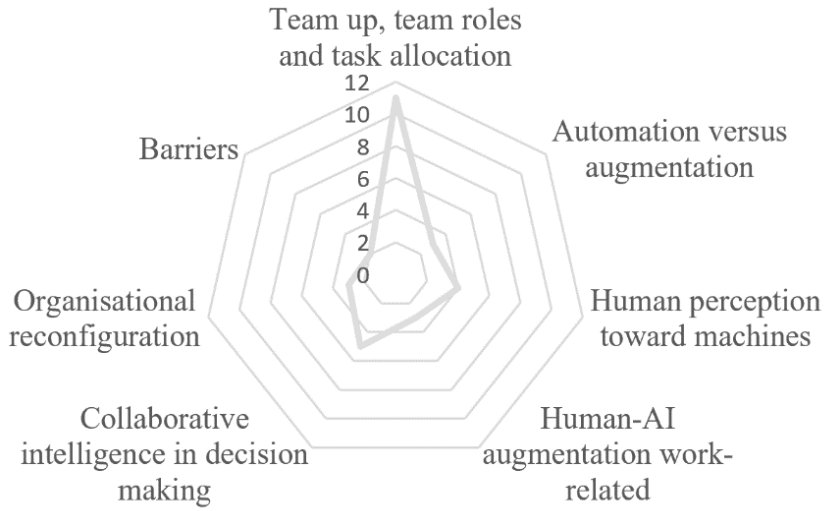

Figure 2. The distribution of identified themes.

4 Findings

In this section, we categorised the identified topics in the literature into three themes as shown in figure 3 and discussed as follows.

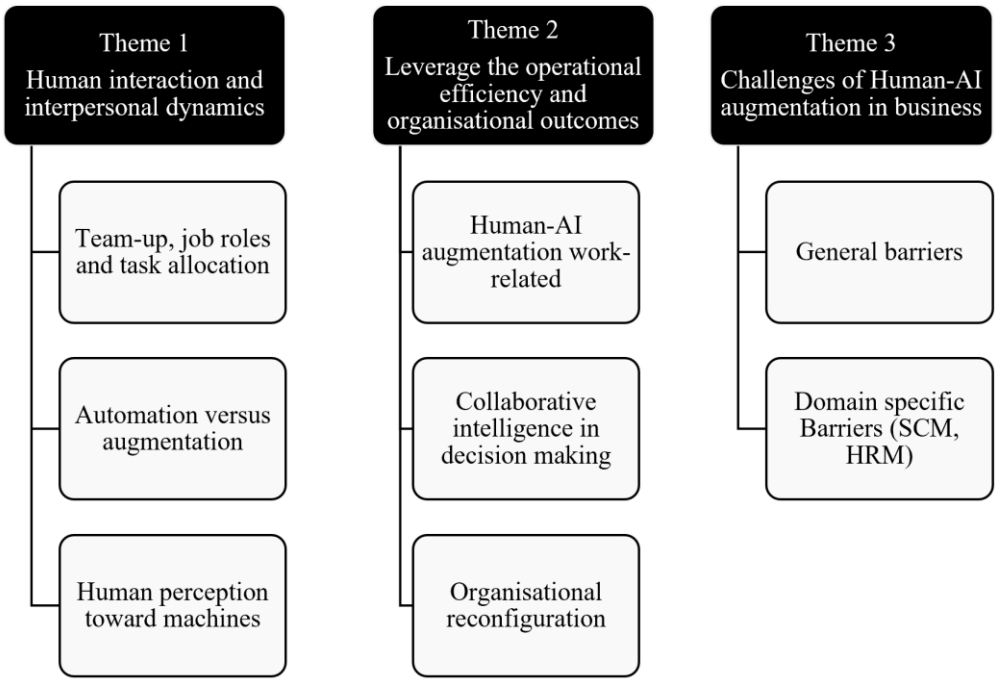

Figure 3. Human-AI augmentation theme-related.

Theme 1: Human interaction and managing interpersonal dynamics (RQ1)

This theme includes topics related to the interaction of humans and machines as a team in the workplace as follows.

4.1 Automation versus augmentation

The discussion of automation and augmentation has received a great deal of attention by scholars, practitioners and policy makers (Benbya et al., 2021). While the human involvement is lacking in a pure automation (Teodorescu et al., 2021b), augmentation is the intelligent collaboration of humans and machines to accomplish a given task (Lebovitz et al., 2022b). The final outcome of automation is fully achieved by machines however, in augmentation, it is stemmed partially from machines and humans. When it comes to the nature of task, an automated system can process repetitive and well-structured tasks but not the complicated ones, which augmentation can address (Brynjolfsson and McAfee, 2014, Wilson and Daugherty, 2018, Davenport and Kirby, 2016). In light of ethical concern, especially fairness consideration, studies are more in favour of augmentation than automation because augmentation can consider the social context (Cooper and Abrams, 2021). Table 1 summarises the main differences in the conceptualisation of automation and augmentation.

Authors disagree on how automation and augmentation come about. For some, automation and augmentation are considered as two different stages of the co-existence of humans and machines (Lebovitz et al., 2022a), where automation is considered as "low-status" while augmentation is seen as "high-status" (Einola and Khoreva, 2023). For others, automation and augmentation are interdependent and permeate the entire organisation (Sowa et al., 2021, Raisch and Krakowski, 2021b). At a certain time, humans can only choose to go for either automation or augmentation for a specific task (Raisch and Krakowski, 2021a). However, recently few scholars argue that automation offers the basis for augmentation and enhances the core process of an organisation (Spring et al., 2022) and hence they are not detached from nor in paradoxical tension as previously argued (Einola and Khoreva, 2023).

Features	Automation	Augmentation
Actors involvement	Fully machines	Partially machines, Partially humans

Output creator	Fully machines	Partially machines, Partially humans
Expectation of AI	Takes over human jobs	Supports human jobs
Nature of task	Simple	Simple and complex
Ethical concern	Higher	Lower

Table 1. The comparison of automation and augmentation

4.2 Humans perception toward machines

Scholars revealed that humans and machines shape each other behaviour through interaction and collaboration (Hitsch et al., 2010, Jennings et al., 2014, Gray and Wegner, 2012, Tsvetkova et al., 2017). Humans influence machines through their daily decisions, actions, and interactions by defining objectives, imposing constraints, selecting the training data, and providing feedback (Deng et al., 2016). Human decision-making is also used in the choice and development of the algorithms to be employed, how to feed back to those algorithms, and what data to train them on (Thomaz and Breazeal, 2008, Christiano et al., 2017). Simultaneously, machines affect humans behaviour by informing, guiding, and navigating human judgements (Lindebaum et al., 2020, Moser et al., 2022). Through thousands of interactions, humans hold different perceptions when collaborating with machines in the workplace. Einola and Khoreva (2023) empirically uncover that different organisation groups may differ in their sense making of the same AI system. They find that this sense making process is shaped by four dimensions: meanings, metaphor, type of changes and characterisation of their co-existence (Einola and Khoreva, 2023). There is no one meaning perceived of AI technology as scholars find that the same AI system can be defined differently by members of various organisational groups. Indeed, different organisational groups assigned different metaphors for their relationship with the same AI system they studied. The type of changes, which are the modifications of work arrangements and organisation that workers need to adapt to, also impact the way the AI system is perceived. Also, they find that different organisational groups would define their co-existence with the AI system differently.

Authors validated that humans attitude toward AI system can be measured by three criteria: technology acceptance, technology self-efficacy, and source credibility (La Torre et al., 2021). Achieving these criteria are also known as the challenges in the collaborative relationship of humans and machines (Arslan et al., 2021, Hangl et al., 2022, Henkel et al., 2020b). Technology acceptance refers to the individual intention toward machines (La Torre et al., 2021). It is a behavioural intention that significantly influences the use, misuse or disuse toward an AI-based system and is shaped by effort expectancy and facilitating conditions (Loske and Klumpp, 2021). Technology self-efficacy is the perception of an individual toward their capacity to take advantage of technological advances for specific purposes (Moreira-Fontán et al., 2019) and source credibility is considered as the human's trust (La Torre et al., 2021). Humans trust in AI system is influenced by AI form and representation (Glikson and Woolley, 2020) and recent research also find that it is influenced by the perception of machine leaning as a form of learning similar to "junior colleagues" (Gkinko and Elbanna, 2023). Interestingly, scholars find that humans tend to react stronger toward machine errors than humans who made the same mistakes (Dietvorst et al., 2015) however in the case of conversational AI, scholars find that users develop a connective emotion that allows them to tolerate and forgive mistakes (Gkinko and Elbanna, 2022).

4.3 Team up, job roles and task allocation

Studies have considered the formation of teams of humans and machines and found that there are three conditions under which humans and machines can collaborate effectively. First, humans and machines can complement each other since they differ in characteristics and hence their strengths provide different intelligence level (Fuegener et al., 2022, Huang and Rust, 2022a). Second, while Fuegener et al. (2022) indicated that machines and humans can self-assess their own capabilities and delegate tasks to each other when tasks cannot be handled by one part alone, Huang and Rust (2022a) suggested that

regarding to task allocation, humans should be in charge of the higher complicated tasks and machines can augment humans in solving tasks which are basic and require lower level of intelligence. Third, when machines are able to solve a task autonomously, it should be assigned to new tasks which involve in a higher level of intelligence requirement. By following that rule, the intelligence level of machines will be trained and enhanced continuously that facilitates humans to concentrate on the difficult tasks, which creates more value for organisations.

When considering an effective collaboration relationship, researchers find that factors such as knowledge-sharing enhances employee understanding of AI capabilities and limitations (Chowdhury et al., 2022), technical resource (data resources, technology infrastructure, and AI transparency) and non-technical resource (financial resources, business skills, culture, and etc) play key roles (Chowdhury et al., 2023).

When humans and machines team up in the workplace, task allocation become based on two factors namely: the nature of the independent relationship and the nature of specialisation (Puranam, 2021a). Firstly, the independence of human and machines refers to the way decision-making process take place, which scholars suggest it can take one of two forms: sequential processing where output of one agent serves as an input for the other or the super-additive value where value is created from jointly created output (Christensen, 2013). Secondly, the nature of specialisation, humans and machines can be assigned to make decisions based on their respective strengths, or they can make identical decisions (Puranam, 2021b). Scholars identify four types of AI intelligence: mechanical, analytical, intuitive, and empathetic (Huang and Rust, 2018b). Mechanical intelligence is used to perform systematic, repeated or rule-based tasks. Analytical intelligence can self-learn from historical data, process information and think logically. Intuitive intelligence is suitable for the high-level professionals which requires innovative problem-solving skills, such as lawyers, doctors or marketing managers. Lastly, empathetic intelligence can understand and react appropriately to human emotion (Huang and Rust, 2018b). While Puranam (2021a) tend to focus on the characteristics of humans and machines, Huang and Rust (2018b) pay attention to characteristic of task for the distribution of work.

Researchers indicated six action possibilities of chatbot in customer service including filtering, informing, monitoring, delegating, multitasking and distilling (Vassilakopoulou et al., 2022). Filtering action is related to the ability of chatbot to respond automatically to customer requests which is basic and pre-programmed (Vassilakopoulou et al., 2022). A research on a law and accountant firm indicated that chatbot lessens disruption and enhances the responsiveness of customer service by filtering and taking over routine activities from customers' requests (Spring et al., 2022). Next, the informing action assists humans to update information precisely and quickly. As machines have ability to rapidly process a huge amount of data (Teodorescu et al., 2021a, Pittman, 2016, Mehr et al., 2017), the monitoring function can detect the emergence of a problem by continuously accumulating information from users (Vassilakopoulou et al., 2022, Spring et al., 2022). The delegating action helps machines to automatically transfer the conversation to humans when necessary to avoid dead-ends in chatbots (Vassilakopoulou et al., 2022). Researchers indicated that organisational performance improves only when machines delegate tasks to humans but not when humans delegate tasks to machines (Fuegener et al., 2022). Multitasking action allows chatbots to solve multiple problems simultaneously while distilling refers to the action of summarising information from a conversation and providing it to humans (Vassilakopoulou et al., 2022). Researchers demonstrated that employee trust in AI and role clarification have positive impact on business performance (Chowdhury et al., 2022) and that trust in AI technology could take a different trajectory than that of traditional enterprise systems (Gkinko and Elbanna, 2023).

AI can play four roles in a team: coordinator, creator, perfectionist and doer (Siemon, 2022). In the coordinator role, machines take responsibility for connecting and leading team members in a group. When taking the role of a creator, it is responsibility of machines to generate ideas or solve problems. In the perfectionist role, AI takes charge of repetitive and operational task, which require high level of details and diligence. Lastly, the doer role involves in the action of "get things done" by the rapid execution of processes (Siemon, 2022).

Scholars explains that the proximity level, which is one of the important aspects in the synergetic relationship of humans and machines, is divided into four stages as competition, supplementation,

interdependency and hybrid (Sowa et al., 2021). The first level of proximity is where humans and machines have no connection or relationship and work on separate tasks (Raisch and Krakowski, 2021b). The next level is supplementation (Sowa et al., 2021), where machines support human work in certain activities (Raisch and Krakowski, 2021b) such as routine and repetitive tasks that do not require human involvement (Huang and Rust, 2018b, Bughin et al., 2017, Davenport and Kirby, 2016). This "interdependency" is the third level of proximity, which demonstrates how humans and machines interact and depend on each other (Sowa et al., 2021). Machine capabilities are not independent; they cooperate with human abilities to produce business value and efficiency (Zhang et al., 2021). At this level, machines need help from humans as it is lacking of data to generate a right predictions and decisions (Looks et al., 2017). The highest level is the hybrid. Here, humans and machines combine into one entity resulting in hybrid organisational systems with collective intelligences (Sowa et al., 2021). Machines are integrated everywhere in the human workplace, embodied in different forms - robotic, virtual or embedded (Glikson and Woolley, 2020).

Theme 2: Leveraging operational efficiency and organisational outcomes

4.4 Human-AI augmentation work-related

Authors argue that AI can enhance overall decision-making procedure (Chong et al., 2020, Qasim and Kharbat, 2020), improve long-term efficiency, and strengthen the sustainability of good and service (Van Veldhoven and Vanthienen, 2022, Cooper and Abrams, 2021). Researchers indicated that implementing AI technologies can enhance interpersonal emotion regulation (IER) in customer service staff (Henkel et al., 2020a). Customer service requires consistent efficiency and stability in routine operation, which is tough as workers' behaviour and mood can change in unexpected ways. Interpersonal emotion regulation, is one of the key requirement for employees working in the service sector where employees should conceal their genuine emotions and keep acting in a particular way in line with corporate image (Tamir, 2011). Many firms have adopted AI systems for customer support such as chatbots to control quality and standard of their service (Schanke et al., 2021b), that resulted in increasing customer satisfaction and improving the mental health of service workers (Henkel et al., 2020a). When designing an AI-based systems in this regard , researchers emphasised the importance of anthropomorphism (Schanke et al., 2021a), which is the inclusion and depiction of some human attributes into machines (Duffy, 2003). Researchers demonstrated that anthropomorphism can increase the efficiency of customer service (Wang et al., 2007) and information disclosure level of customers (Schanke et al., 2021a). In addition, scholars revealed that the implementation of machines improves productivity (Johnson et al., 2022) and increases value co-creation of R&D activities (Johnson et al., 2022, Barile et al., 2021).

4.5 Collaborative intelligence in decision-making

Machines have been participated in decision making process with humans since it is adopted in organisation and the position of final decision maker interchanges flexibly between humans and machines. As fairness is an importance factor in decision making, some scholars based on fairness difficulty level to consider the decision maker between humans and machines (Bazerman et al., 2012, Frank et al., 2019). Fairness difficulty is the combination of several fairness criteria that organisations are required to achieve. The level of fairness difficulty will be high if the high number of fairness criteria is involved in the situation (Teodorescu et al., 2021a). In a high level of fairness difficulty situation, the most effective way to achieve fairness is humans and machines augment and supervise each other to generate a final result (Teodorescu et al., 2021a). Humans role is directing, guiding and training machines toward a suitable conclusion if machines take the role of decision making, and machine role is supervising humans process to ensure that the results are fair if humans are the decision maker (Teodorescu et al., 2021a). In a low level of fairness difficulty situation, if machines is the decision maker, human intervention is required only when machines behave inappropriately. In addition, humans can decide whether or not to follow machine suggestions when they are the final decision maker (Teodorescu et al., 2021a). In a study on HRM department, researchers suggested that fairness challenges of decision making process can be mitigated by knowledge sharing between HR managers

and AI developers (Soleimani et al., 2022). It occurs throughout three stages of developing an AI-based system: pre-development process, development process and post-development process (Soleimani et al., 2022). Specifically, HR managers and AI developers must clearly understand the job function and essential criteria before conducting an AI-based system. HR managers can provide the AI developers with precise labelled data set to train the system. When the system is first completed, HR managers can take some trials and tests a particular group to examine some unwanted biased criteria. AI developers are responsible for adjusting the system based on HR managers feedbacks after a thorough review (Soleimani et al., 2022). In R&D department, knowledge sharing resulted in knowledge integration and value co-creation that enriches organisational capabilities (Kearns and Sabherwal, 2006, Nickerson and Zenger, 2004, Grant, 1996).

Although many researchers agreed that the collaborative intelligence of humans and machines make best performance in decision-making (Fuegener et al., 2022, Cheng et al., 2016, Mayo and Leung, 2018). Metcalf et al. (2019) proposed Artificial Swarm Intelligence (ASI) concept, in which AI is in charge of collecting and generating final results based on the pool of human idea. ASI is the collection of human intelligence and known as a "Supermind", which outperformed machine intelligences (Metcalf et al., 2019). Data gathering process of ASI is anonymous which prevents people from status or reputational pressure. They freely contribute their knowledge without fearing being judged as in any other face-to-face meetings (Metcalf et al., 2019).

4.6 Organisational reconfiguration

The implementation of Human-AI augmentation influenced to work and can create major transformation in the organisation. First of all, the introduction of AI team members creates new job opportunities and diminished other jobs (Faraj et al., 2018, Einola and Khoreva, 2023, Gronsund and Aanestad, 2020, Huang et al., 2019). For example, through US government occupational database, researchers indicated that the emergence of AI technologies gradually transforming the economy from mechanical to thinking and towards feeling economy (Huang et al., 2019). Among the three levels of mechanical (lowest), thinking (medium) and feeling (highest), AI technologies generally take over the two lower levels of tasks difficulty that leads to the transforming of human task characteristics from mechanical and thinking to feeling (Huang et al., 2019).

Secondly, entire organisational structure can be re-configured when AI technologies are implemented (Davenport and Kirby, 2016). Employees modify their activities to communicate with and work alongside AI technologies (Spring et al., 2022). The organisation needs to allocate resources to work with algorithms in two new roles: auditing and altering (Gronsund and Aanestad, 2020). Auditing role is the supervision of humans of the AI performance. Altering role is the continuous training and directing of the AI performance (Grønsund and Aanestad, 2020).

Theme 3: Challenges of Human-AI augmentation in business (RQ2)

Scholars discussed different challenges in having AI in the workplace. In this regard, they find the following. First, "technical limitations" and opacity can cause human workers to experience stress (Hangl et al., 2022, Henkel et al., 2020a, Arslan et al., 2021). Researchers indicated that it is important to organisation to train their employees to use and understand data (Ben-Daya et al., 2019). Second, the introduction of AI in the workplace introduces changes and can be met by internal resistance (Hangl et al., 2022). Accordingly, organisation need to prepare for that changes. Third, the level of human trust (Arslan et al., 2021) and human acceptance (Hangl et al., 2022) towards AI. The implementation of AI relies on humans, so that it is necessary to enhance the willingness of humans to integrate of AI in their work (Riahi et al., 2021, Frederico, 2021, Ng et al., 2021). Fourth, human's underestimation or overestimation of AI capabilities is considered as one of the challenges when collaborating with AI in workplace (Schaefer, 2013, Demir et al., 2020). The final challenge is ethics, security and privacy issues which relates to data quality, data storage, data access and data ownership (Sharma et al., 2020, Ben-Daya et al., 2019). There is a shortage for policy and regulations regarding to the use of data in an open world as we are all living in (Zekhnini et al., 2020).

5 Discussion and future research agenda

Research on the business and management side of AI implementation and research on Human-AI augmentation in particular had increased in the past few years. Hence this paper provides timely review of research. This literature review highlighted the key themes in research on Human-AI augmentation in business and management scenarios including: (1) human interaction and interpersonal dynamics, (2) leveraging the operational efficiency and organisational outcome, (3) challenges of Human-AI augmentation .

In the first themes, reviewed studies suggested different directions on how to develop an effective team of humans and machines such as team-up conditions, AI function and action possibilities, AI team roles, task allocation and human perception toward machines. The findings show that the present of AI as a team member brings several potential benefits for work and organisation. Existing literature reveals that the combination of humans and machines brings the best performance for the organisation when compared to work done solely by machines or humans for both white (Lebovitz et al., 2022a, Jussupow et al., 2021b, Huang and Rust, 2021) and blue-collar workers (Loske and Klumpp, 2021). There are three papers focusing on the comparison of automation and augmentation, which are known as two approaches of AI applications in organisation. Automation and augmentation are demonstrated as co-existing interdependently. Interestingly, while some scholars revealed that automation is the lower level of humans and machines relationship, others suggested that organisation have to achieve augmentation before being automated by machines. The first theme also exposed that the human attitude toward machines fluctuates based on the meaning of AI for each individual, roles and impacts of AI in each situation, the proximity of humans and machines, the trust of humans to machines, the benefits realisation of humans to machines and the humans interaction of using machines.

While the first theme focuses on the interaction between internal actors of Human-AI relationship, the second theme discusses the impact of this relationship to external factors: task, work and organisation. Scholar from reviewed studies agreed that the intervention of Human-AI augmentation can yield benefits to different types of tasks and improve the decision-making process of organisation. The fairness concern received a great deal of attention from scholars when considering decision making process. Researchers showed that humans and machines need to supervise each other in decision-making processes to control the fairness. In addition, knowledge-sharing between users and AI developers also plays important role in securing the fairness aspects of decision-making procedure. Overall, the Human-AI augmentation phenomenon causes two main impacts to organisation are transforming the nature of human work and organisational re-configuration. However, organisation should have a good preparation and suitable strategy for their AI implementation to trigger these advantages instead of getting unexpected outcomes as this collaborative relationship might yield several constraints and shortcomings.

In the last theme, which is also the answer for the second research question, presents the challenges that Human-AI augmentation in business context creates. Challenges can be derived from human sides such as employee technical limitations, human trust, human evaluation of AI capabilities and data privacy concern. In addition, AI integration might generate some resistance to the organisational development at some point of beginning stage. The awareness of these challenges is essential for organisations as they can self-evaluate their capabilities to see whether they are willing and ready to deal with it or not, so they can make a right decision.

Based on the literature review findings, we suggest the following areas for future research:

First, reviewed studies have touched on numerous business activities such as supply chain management, human resource management. However, there is a scarity of study investigating the augmentation of humans and machines in other business domains such as accounting and auditing and sales. Future research is encouraged to clarify the roles and responsibilities of humans and machines in their relationship as well as investigate human reactions to the system in different fields.

Second, ethics has long been a crucial management component recently. Future researchers are called to pay attention to ethical issues regarding Human-AI augmentation. Organisations need deeper understanding of systems and algorithms to balance ethical issues and technical considerations when designing and managing an AI system.

Third, as an AI-based system might be "black-boxed" or opacity phenomenon. Future research should investigate how opacity impacts the relationship between humans and machines and how humans deal with the opacity of an AI-based system.

Fourth, it is crucial to comprehend why some organisations adopt human-AI augmentation successfully while others do not. Studies have been exploring variables that contribute to the success of human-AI augmentation in an organisation. Future researchers are encouraged to concentrate on the failure case study and determine the variables that lead to the failure. These findings will provide managers, practitioners and researchers with a clear understanding of the relationship between Human-AI augmentation and organisation.

6 Limitations

The main target of this study is seeking to shine light on the different facets of Human-AI augmentation relationship in business and management context. Undeniably, we encountered some limitations when conducting this research. Firstly, we used several keywords within search string to search for the related papers with our topics, that might prevent our work from gathering papers which emerged outside from our keywords in search string. To mitigate the bias related to term selection, we searched for main keywords and its closest synonyms, which were recommend from other author to boarden the search result. Secondly, we also limited our search in English content only, publications in other languages were not considered in our research. Thirdly, we also encountered some difficulties in term of accessing the literature content, which we have to remove from our reviewed papers list. For any papers, which cannot be accessed from WoS, we searched for its availability from other sources such as google search, google scholars search, sciencedirect or elsevier database. Lastly, the literature review was limited to publications in the business and management disciplines. We are aware of that the review could be more valuable if papers from other disciplines are included. However, we limited our search for business and management only due to the high number of search results.

7 Implication for research and practice

This literature review provides a comprehensive overview of the notion of human-AI augmentation as discussed in business and management. Through our study, scholars from any other disciplines can gain general understanding of AI performance as a team member in business context. In addition, this review also highlights the gap in term of Human-AI augmentation research area. That creates several research opportunities for scholars who are interested in exploring AI technology in business context.

In terms of practice, the study provides practitioners and policymakers a general guidance on AI and the change in the businessorganisations. There would be some new rules that organisational member are recommended to follow to fully utlise the benefits from machines, which facilitates business to attain performance enhancements and competitive advantages in the market. In addition, this paper also highlights several obstacles that organisation might face when integrating AI into their business system. Accordingly, organisation should consider the capabilities required to overcome these challenges and determine the optimal timing for AI integration into their system. The study supports organisational understanding of the factors necessary to achieve a successful Human-AI augmentation. We hope that the synthesis of literature provided in this study support knowledge accumulation and provides a base for future research on Human-AI augmentation.

Appendices

A. Key Human-AI augmentation related organisational themes

No	Author	First-order themes	Second-order themes	Aggregate dimensions
1	Vassilakopoulou et al. (2022)	Action possibilities of AI by chatbot in customer service.	Team up, team roles and task allocation	**Human interaction and managing interpersonal dynamics**
2	Fuegener et al. (2022)	Requirement to achieve an effective collaborative relationship		
3	Huang and Rust (2022b)	How human marketers and consumers can collaborate with AI.		
4	Siemon (2022)	Four team roles for AI teammate		
5	Puranam (2021a)	Different forms of division of labour between human and algorithm		
6	Huang and Rust (2018b)	Four intelligence required for service tasks		
7	Huang and Rust (2021b)	How to use different AIs to engage customers based on considerations of nature of service task		
8	Sowa et al. (2021)	Four proximity level of relationship		
9	Chowdhury et al. (2022)	Factors impact on Human-AI partnership		
10	Chowdhury et al. (2023)	Propositions to improve AI implementation in HRM.		
11	Huang and Rust (2022c)	How to best serve AI customers		
12	Einola and Khoreva (2022)	The relationship between humans and AI	Automation versus augmentation	
13	Spring et al. (2022)	How AI-based systems collaborate with humans in workplace		
14	Raisch and Krakowski (2021c)	The automation and augmentation concepts in the management domain		
15	Chuang (2022)	Employees skill requirement in the age of robots and AI	Human perception toward machines	
16	Einola and Khoreva (2022)	Four dimensions that humans shape their perception toward to machines		
17	Loske and Klumpp (2021)	The impact of truck drivers' behavioural intention on actual technology use		
18	La Torre et al. (2021)	Three criteria to measure the human attitude towards AI		
19	Henkel et al. (2020b)	AI-based system augmented service employees in emotion recognition software	Human-AI augmentation work-related	**Leveraging the efficiency of business operations**
20	Schanke et al. (2021a)	The impact of human attributes inside a machines to task performance		
21	Johnson et al. (2022)	How firms implement AI in research and development		
22	Teodorescu et al. (2021a)	Typology of augmentation for fairness	Collaborative intelligence in decision-making	
23	Malik et al. (2022)	AI-enabled HRM applications and knowledge-sharing		
24	Metcalf et al. (2019)	Artificial Swarm Intelligence and decision making		
25	Soleimani et al. (2022)	The knowledge sharing in mitigating biases		
26	Di Vaio et al. (2022)	The collaboration of humans and machines in improving overall decision-making		
27	Maragno et al. (2022)	How AI introduction affects public entities at the micro-level	Organisational reconfiguration	
28	Huang et al. (2019)	A theory of AI job-replacement		
29	Gronsund and Aanestad (2020)	The new configuration of organisations in the age of machines		
30	Hangl et al. (2022)	Barriers of using AI in supply chain management (SCM)	General and domain specific barriers in SCM	**Challenges of Human-AI augmentation in business**
31	Arslan et al. (2021)	Challenges that human resource management (HRM) when implementing AI	General and domain specific barriers Barrier in HRM	

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