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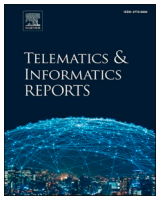

Artificial intelligence research: A review on dominant themes, methods, frameworks and future research directions

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ABSTRACT

This article presents an analysis of artificial intelligence (AI) in information systems and innovation-related journals to determine the current issues and stock of knowledge in AI literature, research methodology, frameworks, level of analysis and conceptual approaches. By doing this, the article aims to identify research gaps that can guide future investigations. A total of 85 peer-reviewed articles from 2020 to 2023 were used in the analysis. The findings show that extant literature is skewed towards the prevalence of technological issues and highlights the relatively lower focus on other themes, such as contextual knowledge co-creation issues, conceptualisation, and application domains. While there have been increasing technological issues with artificial intelligence, the three identified areas of security concern are data security, model security and network security. Furthermore, the review found that contemporary AI, which continually drives the boundaries of computational capabilities to tackle increasingly intricate decision-making challenges, distinguishes itself from earlier iterations in two primary aspects that significantly affect organisational learning in dealing with AI's potential: autonomy and learnability. This study contributes to AI research by providing insights into current issues, research methodology, level of analysis and conceptual approaches, and AI framework to help identify research gaps for future investigations.

1. Introduction

In recent times, the widespread adoption of computers has surged dramatically, fundamentally altering the dynamics of business operations and competition as an imperative for long-term viability. To address these imperatives, there is a need for efficient allocation of resources and innovations. Artificial Intelligence (AI), an evolving innovation, aims to address these imperatives. While AI is not entirely novel, its commercialisation gained momentum around 2000. AI, in essence, is a simulation of human intelligence in computer systems [1]. AI comprises the development of algorithms, software, and hardware that enable machines to perform tasks that typically require human intelligence [2–4].

AI is still garnering attention, leading to a slow but steadily growing body of research (e.g. [5]). While these reviews have provided few valuable insights into AI in other domains [6,7], huge knowledge gaps persist, underscoring the need for further examination of information systems (IS). Thus, AI in information systems research is a new technology for gathering information, generating results, interpreting it, improving decision systems and being able to interact with its environment [8]. The decision-making process of AI is often not transparent and determinative [9]. Thus, a deeper understanding of AI in IS is needed to establish conventional functions of AI studies.

Furthermore, despite the increasing popularity of AI and its societal influence [10–12], we lack a comprehensive understanding of what we know and what we need to know about AI and how people experience it. Prior studies have called for researchers to give more clarity in defining AI, even if that means redefining it away from traditional human intelligence and conducting more research on societal and personal effects that advance AI in everyday life [13]. This study seeks to provide an enhanced understanding of the knowledge and conceptual gaps and contribute to the practical implementation of AI in IS. Concisely, this paper provides a review and analysis of artificial computing from 2020 to 2023. The emphasis is on dominant theories and themes, methodologies, frameworks, trends and research direction for understanding AI in recent times.

1.1. Early days and initial paradigms of artificial intelligence

There is an extended history of AI, but its modern iteration evolved

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around the 1950s. Credit to Alan Turing and the conference held at Dartmouth College, the term Artificial Intelligence was framed and defined as "the science that makes machines intelligent" by John McCarthy in 1956 [14,15]. Thus, the early AI focused on machine development that was capable of making decisions that only humans could accomplish. The initial paradigm of AI had the potential to reason multi-step, create innovative solutions, comprehend natural language and even contemplate its own thinking – hereby referred to as strong AI [13]. The main characteristic of the strong AI is its general symbolic manipulators (reasoning); however, it lacks the progressive capabilities of the 21st-century AI model.

From 1974 to the early 1980s, a period referred to as the first winter of AI witnessed reduced funding. Consequently, it lowers the hype and interest in the field of AI [16]. Fast forward to 1997, IBM's Deep Blue computers surpassed the reigning world chess champion – G. Kasparov. This defeat is important in the history of AI research because it proved that computers could surpass human intelligence in goal orientation. Subsequently, deep blue became an integral part of financial modelling and health systems resilience.

The early 2000s to date started to witness Stanford vehicles driving autonomously across the desert, while IBM's Watson won the "Jeepardy". Watson's feat was essential to the development of AI breakthroughs in Natural Language Processing. This breakthrough helped to dispel fears and some scepticism surrounding AI and highlighted numerous ways of benefiting humanity. Generally, the idea of AI is ancient until its significant technological advancement in the mid-20th century [15]. However, the explosion of ubiquitous AI and real-world applications is relatively new and rapidly evolving, hence the conceptualisation of divergent perspectives.

1.2. Definition of artificial intelligence

The AI phenomenon has its genesis in other technologies, namely computing power, machine learning, big data, cloud computing, open-source software, algorithms and virtualization [17,18]. Features that distinguish AI from related technologies are its ability to learn, adapt, reason and decision-making. In addition to handlinguncertainty and noise, interaction and collaboration, and representation and abstraction [19,20]. Currently, there is no standard definition of AI. However, significant strides are made by academics, government institutions and industry players for a standard definition of AI components. The lack of standardization stems from the fact that smart technologies such as smartphones and smart homes are referred to as AI just as autonomous technologies (e.g. self-driving cars and drones) [21]. Due to the lack of a standard definition of AI, current literature reviews call for studies and reviews to broaden the scope of frameworks, themes and research direction. However, an attempt by [11] define AI as an "unnatural object or entity that possesses the ability and capacity to meet or exceed the requirements of the task it is assigned when considering cultural and demographic circumstances." For this review, AI is defined as a model that possesses the ability to reason, learn and act autonomously as human behaviour [22]. Recent literature reviews [10,11,13] on information systems in AI have tried to address the definitions, contextualisation, business value and frameworks of AI; however, several research gaps exist to necessitate this study (see Table 1).

1.3. Domain terminologies in artificial intelligence

Researchers have often described AI with numerous domain technologies that range from natural language processing (NLP) to computer vision and machine learning. While these terms are closely related to artificial intelligence, they differ in their goals and dedicated purpose. Some articles used AI, NLP, computer vision, machine learning, autonomous robotics and recommender systems interchangeably and did not clearly define them. Based on the frequently used terms in the review, the following are clearly defined:

Table 1
Research gaps in prior reviews.

Article	Research issue	Conceptual approaches	Identified gaps
[10]	ü Business models of AI ü Bibliometric analysis and review of AI ü Role of AI in sustainable business models	Cultural drift based on AI, sustainable business model and knowledge management systems Business model concepts, organisational memory, AI methods and networks	ü Need to adopt a quantitative approach to review AI research ü More systematic review for our understanding of AI in business
[13]	ü Review on the business value of AI ü AI in information systems implications	Value types of AI include: i) process automation, cognitive engagement and cognitive insight Conversational functions typical of the human mind	ü Lack of consensus around the definition and themes of AI ü Need for review on technological, performance, and contextual aspects of AI
[23]	ü How to effectively integrate AI and organizational strategy	Conceptual approaches involve the intersection of AI themes, sources of value creation and business strategy themes e.g. alignment with IT	ü Insight into new AI tools to align with business strategy and contextual needs of organisation
[11, 22]	ü Review on frameworks and factors influencing acceptance of AI	Framework to assess AI: i) built on adoption theories and actual use behaviour of AI ii) Issues with AI replication iii) Reliance on self-reported data	ü Need to examine the impact of AI on the level of analysis ü Inconsistency in the definition and operationalisation of themes of AI

Natural language Processing describes the interaction between computers and human language and includes technologies like language transactions, chatbots, sentiment analysis (emotional tone of text) and entity recognition to function [24].

Computer vision constitutes an enabling machine used to understand and interpret visual data from videos and images. Some of the key features include object detection, image classification and segmentation, and facial recognition.

Machine learning is a foundational technology of AI and includes supervised learning, unsupervised learning, deep learning and reinforcement learning (training agents) necessary to initiate communication. Compared to supervised learning, unsupervised learning tends to discover patterns in an unlabelled data structure.

Autonomous robotics describes how machines in real-world environments operate independently when AI is integrated with robotics. Key enabling technologies of autonomous robotics include sensor fusion, simultaneous localization and mapping, and path planning and control.

Recommender systems consist of collaborative filtering, content-based filtering and hybrid approaches that are used to provide personalized recommendations to users.

2. Framework taxonomy

Artificial intelligence is a rapidly evolving, complex and diverse field with various applications and components, making the classification of its literature a challenge. Given its wide-ranging applications and diverse subfields, any attempt to categorize AI literature must consider the many facets and complexities inherent to this rapidly evolving field.

In this regard, the classification themes of [25]were adapted to reflect the diverse themes in AI literature and its current happenings. Table 2 shows the classification of AI into four (4) main themes and twenty-five (25) sub-themes. The main themes include technological issues, contextual issues, conceptualisation and domains and applications.

The technological issues border on the technological implications of AI. The sub-themes under technology issues consist of data quality and quantity, bias, model interpretability, scalability, ethical AI design, explainable AI (XAI), AI governance and regulation. The contextual issues theme espouses studies that focus on contextual conditions and consequences of AI including sub-themes such as ethical considerations, privacy concerns, bias and fairness, job displacement, social acceptance, and regulatory and legal challenges. The sub-themes mostly border on studies related to privacy, bias and fairness of AI. Concerning the conceptualisation of AI, the sub-themes include articles that offer insight into AI frameworks and predictability and also its safety and control. AI conceptualisation aims to offer a better understanding and insight into the phenomenon based on contextual development and use. Lastly, the domain and application of AI are focused on sub-themes such as e-health, fraud detection, chatbots, computer vision, game design and personalized learning, as well as smart grids.

3. Methodology

The review primarily relied on electronic database searches, a standard approach in IS research. Initially, the emphasis was on senior IS journals, but these journals yielded few studies on AI (e.g. ChatGPT), likely due to the limited access to papers and conceptual complexity of the subject in recent times. Thus, more articles and publications were found in the Scopus, AISeLibrary and Web of Science databases. Consequently, a more extensive search was conducted across these databases, targeting peer-reviewed scholarly journal articles published between 2020 and 2023. Table 3 shows the strings considered in the search process that yielded 85 articles for analysis.

To ensure the quality of the selected articles, a manual filtering process excluded editorials, review articles, reports, conference papers, dissertations, books, working papers, and articles from non-IS disciplines. Exclusion criteria also applied to non-peer-reviewed papers, duplicate articles, simulation studies and studies with no focus on AI. This meticulous process led to the inclusion of 85 articles for further analysis. Fig. 1 shows the breakdown of the final inclusion criteria.

These articles were categorized based on multiple criteria, encompassing themes (comprising four major and 26 sub-themes), research methodologies (qualitative, quantitative, mixed methods, simulation, experiment, or "no method"), geographical focus (continental), level of analysis (micro, *meso*, macro), publishing outlets (journals), and research frameworks (including a category for studies lacking a specific framework).

In summary, this review leveraged electronic database searches to identify peer-reviewed papers on AI between 2020 and 2023. These articles were subsequently organized and analysed using diverse criteria, providing a comprehensive perspective on the research landscape within this field. The chosen journals for the review are significant in AI research as many strides have been made in defining and contextualising AI. Some of the information systems included in this review include Decision Support Systems, Journal of Strategic Information Systems, MISQ, European Journal of Information Systems, Intelligence, Computers in Human Behaviours, International Journal of Information Management and Information Systems Management.

Table 2
Artificial Intelligence Framework Taxonomy.

Themes	Sub-themes
Technological issues	Data quality and quantity, robustness, bias, model interpretability, scalability, ethical AI design, explainable AI (XAI), AI governance and regulation
Contextual knowledge co-creation issues	Ethical considerations, privacy concerns, bias and fairness, job displacement, social acceptance, cost, regulatory and legal challenges
Conceptualisation	AI safety and control, AI predictability, ethical AI frameworks
Domains and applications	e-health (disease diagnosis), fraud detection, Chatbots – NLP, robotics, computer vision, game design, personalized learning, cybersecurity, smart grids

Table 3
Strings considered in the search process.

Scientific database	Search string
Scopus	TITLE-ABS-KEY (“Artificial intelligence” OR “Machine learning” AND “Information systems” OR “Information technology” “Innovation” “AI Domains” “AI + Technological Issues” “AI Applications” “AI + Machine”
AISeLib, Web of Science	TS = (“Artificial intelligence” OR “Machine learning” AND “Information systems” OR “Information technology” “AI” AND “Contextual” OR “Conceptualisation” “Frameworks”

4. Findings and discussion

4.1. Outlets of publication

The distribution of the journals with their corresponding statistics is as follows. The journal with the highest number of publications among the listed articles is "Nature Machine Intelligence," with eleven articles published in different years (2020, 2022, and 2023). The journal is specifically tailored towards AI and machine intelligence hence no surprise with its appreciable figure (e.g. [6,18,26]). The AI & Society (e.g. [27,28]) was the second-highest journal followed by the European Journal of Information Systems (e.g. [29,30]).

The rest are Discover Artificial Intelligence (2022), Journal of Industrial Information Integration, MIS Quarterly, Engineering Applications of Artificial Intelligence, Frontiers in Medicine, Frontiers in Artificial Intelligence, The Innovation, Intelligence, Electronic Markets, IEEE Transactions on Industrial Informatics, Artificial Intelligence in Medicine, Journal of Computer Information Systems, MIS Quarterly Executive, Computers in Human behaviour, Science China Information Sciences, International Journal of Information Management, Journal of Science Education and Technology, Interactive Learning Environments, Information Systems Management, Technological Forecasting and Social Change and Critical Care. The review found that few publications have been recorded and are accessible in the basket of eight (8) information systems. A possible reason is that, since AI research moves quickly, some good journals often have longer review times, which might delay the latest advancement in these journals. As individuals and organisations continue to adopt it, more publications will be recorded in the top information systems journals and in real-time for further reviews and insights.

4.2. Dominant themes

As stated earlier, the dominant themes are classified based on the typologies of [25] to reflect the current development of AI. The breakdown of articles classified under different themes in AI research is as follows. Themes under technological issues were (36.5%), contextual issues (25.9%), domain and application (23.5%) and AI conceptualization represented 12.9%. Considering that AI is underpinned by technical elements like machine learning, deep learning, NLP, speech recognition, fuzzy logic and expert systems, it comes as no surprise that technological issues theme comprise the majority of the literature. The prevalence of the technological issues theme also highlights the relatively lower focus on other themes, including AI contextual issues, conceptualisation, and application domains (see Fig. 2).

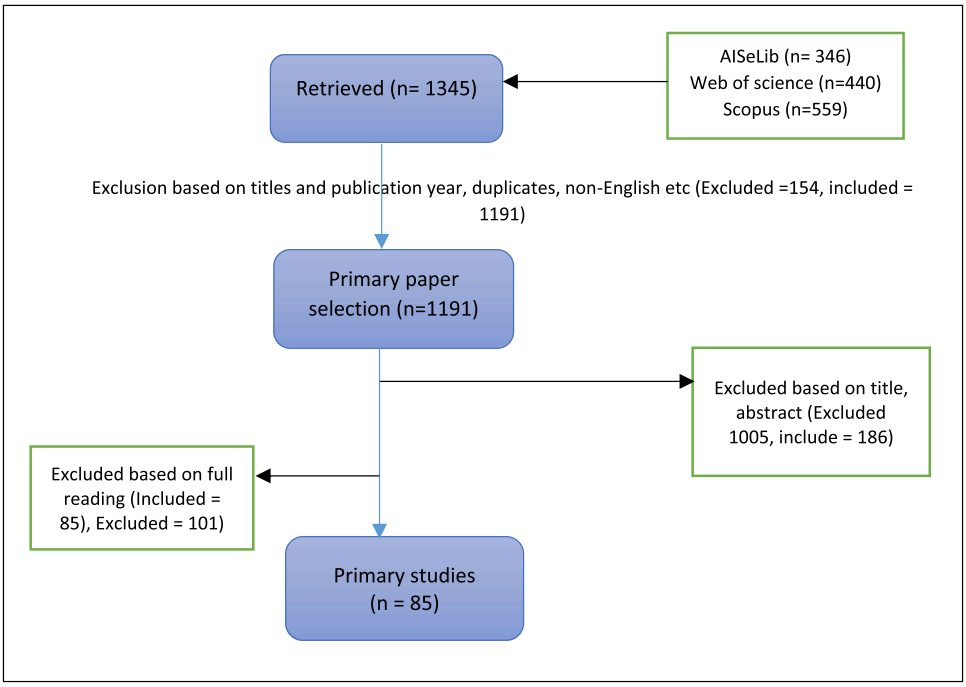

Fig 1. Review Selection Process.

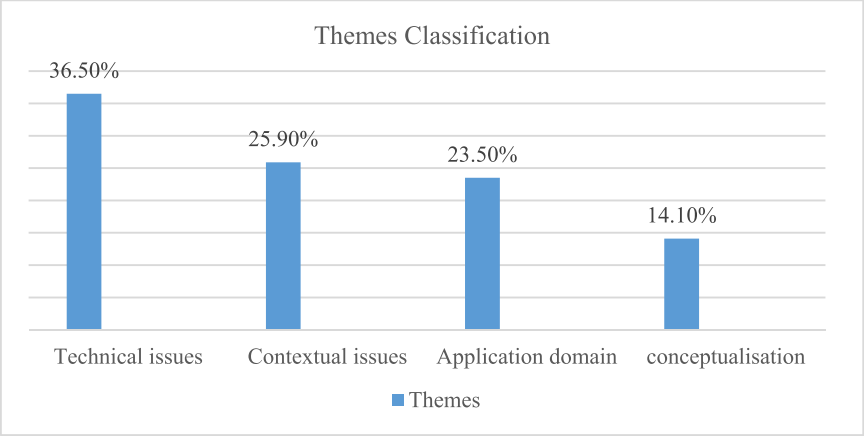

Fig 2. Classification of Themes.

The Technical or technological issues theme focuses on infrastructure that supports data quality and availability. Issues examined under this theme include AI scalability and explainable AI, security, robustness and architecture, and interpretability. AI data quality and scalability studies (e.g. [19,31]) shed light on the models and data that support model construction and argue for improvement in defining, identifying and explaining errors in data. These studies also point out that AI constantly requires vast amounts of high-quality data to learn and make accurate predictions devoid of bias and inconsistencies leading to inaccurate results. Thus, the performance of AI needs significant improvement based on high-quality data in the form of 4 Vs (volume, velocity, veracity and variety).

Studies [26,28,32,33] relating to security, robustness and architecture of AI under technical issues identify adversarial attacks and model vulnerabilities, generalization and data privacy, and interoperability, real-time processing and model complexity as enablers for AI optimization. Furthermore, these studies identify factors such as personalization, social presence, compatibility, responsiveness and anthropomorphism for improving the sustainability of AI services. These factors are not exhaustive as contextual issues differ in implementation and adoption. Thus, AI cannot achieve true human predictive behaviour by solely relying on one paradigm but its novel development for a safe and reliable AI should be premised on a new explainable and robust AI theory.

Studies in AI service management have examined the diverse range of services delivered via AI infrastructure. Depending on most organizational AI applications and setup, these AI services fit the following cloud service models: SaaS, PaaS and IaaS [34]. Some of the AI services include customer support and chatbots, predictive analytics, recommendation systems, fraud detection, voice assistance, content generation, healthcare diagnostics and security and threat detection [35–39]. The underlying discussion amongst these studies is data protection and cloud security, standardization and regulatory frameworks and governance mechanisms.

The inherent characteristics of AI make its adoption a challenge. The recurring concern of AI is security. Even though providers of AI services continue to provide assurances and make strides in solving the challenges, the issue of security is a major hindrance amongst adopters. The

three areas of security concerns include data security, model security and network security. Data security emphasises the foundation of trust in AI development. Researchers in this space focus on data classification and minimization, anonymization and masking of data and developing threat detection and response mechanisms [26,38,40,41]. At the same time, the model security can be referred to as a system for guarding the gatekeepers. Research on model security, which is more progressive has focused on explainability, resilience, interpretability and continuous monitoring and retraining [10,34,35,42]. Finally, are the walls between the systems – referred to as network security. Development in network security prioritises infrastructure or API security, threat intelligence and intrusion detection systems [37,40,43,44]. Table 4 shows some major security issues of AI and measures geared towards addressing them.

The literature acknowledges that securing AI is an ongoing process that requires a multidisciplinary approach and collaboration amongst data scientists, AI researchers and legal teams.

Finally, the prevalence of technological issues is attributed to the fact that deep learning and massive amounts of data currently dominate the field. However, the overreliance on technological progress without investigating the contextual or theoretical foundations of intelligence may hinder the advancement of truly building AI responsible [30] for adapting to its environment and beyond specific issues. To address the overreliance on technological issues, AI research must promote a balanced approach of diverse AI methodologies, mitigate biases in large datasets and democratize AI research to foster open-source initiatives.

The ***contextual knowledge co-creation issues*** theme encompasses research concerning the socio-technical aspects of AI, including acceptance, adoption, integration, cost and ethics. Essentially, it involves collaboratively building knowledge specific to a particular context for a comprehensive understanding of an issue or situation. In contrast, the majority of studies in the contextual issues theme predominantly focus on the adoption and acceptance of AI in various domains, specifically examining factors influencing its acceptability in work activities. These adoption-focused studies (e.g., [11,31,43,47]) primarily explore organisational adoption of AI, with less emphasis on individual and country-level adoption.

Concerning the acceptance and adoption of AI, the review identified psychological anthropomorphic AI devices, perceived value, technology readiness, management support, compatibility and AI generalisation [11,47–49]. This shows a high degree of organizational acceptance and adoption of AI. Hindrances to AI adoption include privacy concerns, lack of education and training, transparency, trust, and cultural and social factors in some developing economies [10]. Addressing these contextual issues is crucial for fostering widespread acceptance of AI technologies and ensuring that they are developed and deployed in ways that benefit society while respecting ethical and legal considerations.

The issue of privacy and trust was well espoused in the literature [37, 46]. The primary focus of these studies revolves around addressing trust-related challenges that could emerge due to the adoption of AI. A proposed legislation, as advocated by Floridi [45] serves as protective measures for AI users and aims to mitigate fears and reduce security concerns associated with cloud innovation.

The debate about the bias and fairness of AI has received less attention, however, concerns have been raised about regulatory frameworks and legal challenges and how to ensure social acceptance [1,18, 50]. Thus, the non-existence of universal laws governing AI in education, health and organisations has been the main challenge of AI adoption (Mikalef et al. 2020; [28]). Given the intelligence level and storage of data in the cloud, more studies have called for measures to ensure confidentiality and transparency [33] of AI, especially chatbots and ChatGPT. In terms of cost, some papers debate that it is a challenge to maintain AI in the long run and suggest improved AI sustainability [32]. However, AI has lowered technology adoption costs and proved to be cost-effective for startups [38]. In short, the main barriers to AI adoption identified in the papers include *cost, data security and privacy concerns, trust issues, perceived risks and job displacement.*

The third examined theme is ***artificial intelligence conceptualisation.*** Articles [6,17,41,49,50] in this domain seek to provide a substructure and a starting point for AI. Given the nascent field of AI, it is important to explain basic concepts and processes to promote the field. This theme views AI research from three main lenses – operational understanding, technical understanding, and theoretical understanding. The operational articles seek to provide an understanding of how individuals comprehend the practical aspects of AI and how it can be deployed in various domains. Thus, studies with an operational understanding try to exemplify what AI applications can do and how they generally work [51–53]. The technical understanding of AI encompasses a deeper knowledge of the technical underpinnings of AI and how the models, algorithms and data process techniques are used in AI-based technologies. Understanding the technical issues involves hands-on

Table 4
Security Issues in Artificial Intelligence .

Security issue	Measures addressing issue	Potential implications for IS future research	Literature sources
Data security	Data encryption – encrypting sensitive data to prevent unauthorized access Access control – implement strict access controls to only authorized users who can access and modify data Data privacy – strict compliance with data privacy regulations to protect AI applications and user data	Systems vulnerability to adversarial attacks developed to manipulate output or distort sensitive information. Decision-making processes may be complex to understand. However, AI can aid the advancement of security solutions in IS, e.g. threat prediction	[26,38,40, 41,45,46]
Model security	Model testing and protection – thorough testing of AI models to identify vulnerabilities to ensure reliability and safety.	There is an enhanced system of trust and reliability. However, the prevalence of AI in IS creates new attacks for malicious players i.e. potential for unintended consequences and misuse	[10,34,35, 42]
Network security	Firewalls and intrusion detection and prevention – the use of firewalls and deploying of intrusion detection to monitor and block malicious activities.	Implication for enhanced data protection (i.e. secured networks) and improved research reliability and accuracy. However, excessive network security measures may hinder information sharing and collaboration. There is a need to strike a balance between security and openness to improve innovation and collaboration in IS.	[37,40,43, 44]

Table 5
Overview of research methods .

Research method	Approach	Percent
Qualitative	Survey and interviews Case studies and interviews	14.2%
Quantitative	Experiment Statistical analysis Experiment and case study Survey and experiment Design science	49.4%
Conceptual	No methodology	24.7%
	Other e.g. Design science	11.7%

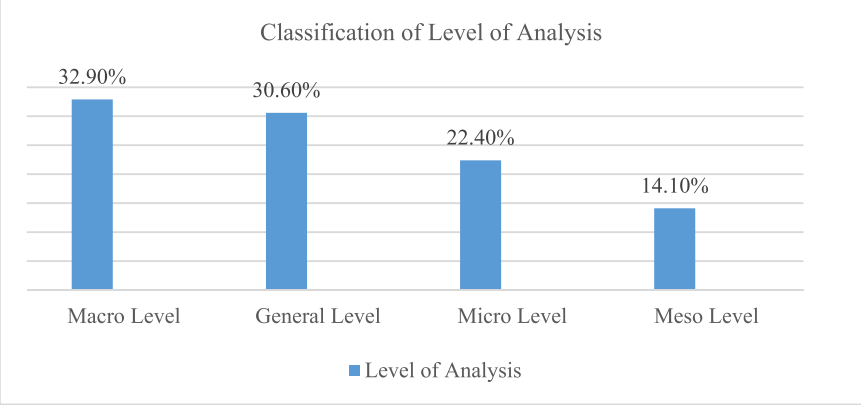

Fig. 3. Literature Classification of Level of Analysis.

Table 6
Research frameworks.

Research framework	No	Percent	Examples of some papers advancing AI-based theory	Theoretical advances of AI (boundaries)
No theory	21	24.7%		
Technology acceptance model	10	11.8%	Pillai, R. and Sivathanu, B. [68]	**Autonomy**
Fuzzy logic	6	7.1%	Spengler, T., Volkmer, T., & Herzog, S. [4]	*Characteristics*
Self-determination theory (SDT)	4	4.7%	Jimenez-Barreto et al. [69]	*Social context*
Critical theory	5	5.9%	Grover, V., & Lyytinen, K. [65].	*Generative AI*
Anthropomorphism theory	5	5.9%	Han, M. C. [70] Blut, Wang, Wünderlich & Brock [2]	*AI and human integration*
Knowledge-based View	9	10.6%	Cooper, Pereira, Vrontis, & Liu, [66].	*Manual generation of reasoning*
Social presence theory	6	7.1%	Jiang et al. [56]	*AI affordances driving the pace*
Unified theory of acceptance and use of technology (UTAUT	5	5.9%	Moriuchi [71]	*Understanding anthropomorphism*
Social response theory (SRT)	4	4.7%	Adam, Wessel & Benlian. [72]	**Learnability**
Social cognitive theory (SCT)	4	4.7%	Henschel, R. Hortensius, E. [67]	*Characteristics*
Uses and gratification theory (UGT)	1	1.2%	Chang et al. [73]	*Human-driven data analysis*
				Structured data
				Adversarial learning
				Extending the resources and knowledge
				Insights from new contexts
				Interpretability
				Performance

experience in programming AI systems [54,55]. Finally, is the theoretical understanding of AI which involves cognitive science, mathematical principles and the philosophical foundation of AI. The theoretical sub-theme provides deep questions about what intelligence is and how AI applications can replicate it [5,43,56,57].

The last theme is the ***application domain*** in which AI has been applied. The publications in this theme examine the application of AI in scientific research and medicine [35,41], education [58], e-governance [20], legal [45], industry [17], customer service [38,47,59], advisory systems [42], sustainable entrepreneurship and SDG [10,60] and computer network security [40]. The studies identified recognize the positive impact that AI has brought to these domains. In this regard, these studies promote the development, application and use of AI-based systems to support business processes in these areas. Scholars in these domains assert that the existing advantages derived from AI could be further enhanced through the development of new AI applications. Researchers are encouraged to contribute more to the less dominant areas such as transportation, green IT, agriculture, climate modelling, cybersecurity, energy and utilities, compliance and retail and e-commerce.

4.3. Overview of research methods

As shown in Table 5, different research methods have been used to study AI such as surveys, case studies, experiments, and statistical analysis. Given that AI is now gaining research momentum in information systems, most of the studies are conceptual (24.7%) and editorial in review (e.g. [1,30,50]) with less established research methodologies. For example, Dietzmann et al. [61] proposed a conceptual design cycle and iterative AI to understand possible synergies for financial services. Few of the studies (14.2%) used qualitative research (e.g. [51,53]) while majority of the studies used simulation and experimental frameworks (e.g. [33,39,42,62]). 34% of the studies either used quantitative such as experiments, surveys and statistical analysis (e.g. [32,58]) or mixed research methodologies such as surveys and interviews, and case studies (e.g. [36]). Experimental research was the most dominant research method used to conduct AI research. Thus, the experimented studies provided improved and quality data on the use of AI in context and environmental analysis. Other studies (11.7%) did not include any methodologies, possibly because of the infant nature of the AI domain. Interestingly, previous literature reviews [1,7] did not include research methodologies, hence, this study provides a good starting point for research into AI. Consequently, calls are made for the use of well-established research methods in future to advance AI research.

Interestingly, several research used multiple techniques as a methodological approach in AI research for gathering data. Surveys were the underlying research methodology for both qualitative and quantitative methods (see Table 5). The most popular research method for AI research is experimentation. As AI continues to advance in IS field, experiments and surveys play a crucial role in testing and validating hypotheses, understanding AI behaviour in context, benchmarking and comparing algorithms and discovering unforeseen biases and challenges.

4.4. Level of analysis

As shown in Fig 3, the majority of the studies focused on how organisations (32.9%) implement and use AI as compared to the individual level (22.4%) of analysis where investigations delved into user experiences. The overreliance on organizational research underscores the

Table 7
Contemporary AI and Earlier AI in Organisational Learning.

Organizational learning	Earlier Iterations of AI	Contemporary AI
Decision-making capabilities	Primarily respond to a programmed request	Independent decision-making
Level of learning	Primarily static and rule-based	Adaptation and continuous learning
Results-orientated	Self-determined goals	Rigid predefined goals
Human interaction	Significant human interaction	Reduce human interaction

continuing recognition of the significance of IS within organisations. Furthermore, a substantial number of the papers fell under the general studies category (30.6%) due to the complexity and technicality of the area. Thus, these studies do not fall under organizational (macro level), country (*meso* level- 14.1%) or individual level (micro level) analysis. As such they provide a general insight into AI research. More studies are needed on AI research at the individual, country, and global levels to bridge the research gaps [20,35,49] in understanding the various classification levels within AI.

4.4.1. Impact of AI on level of analysis

Technological developments have played a pivotal role in shaping organisational processes and procedures since the advent of email communication. In recent times, the advancement of these innovations has promoted digital transformation initiatives that facilitate the exchange of information and prominence in business strategy. However, the integration of data science and machine learning, and artificial intelligence (AIML) has advanced the efficiency of business operations [3].

The current trend of AI has had a positive impact on business performance and management, distribution channels and pricing strategies and not only the improvement of information quality [3]. However, the over-reliance on AI-based technologies may result in added pressure on employees and a risk of disconnection from potential customers or users. For example, Ofosu-Ampong & Acheampong [63] found that while organisations promoted technology-based solutions during the advent of covid-19 pandemic, users were reluctant to change their mode of preferred operation and engagement. In this regard, more research is needed to investigate new business models with AI and how it can strengthen firm-customer relationships to prevent wastage. Thus, AI should promote opportunities that strategically manage user or organizational retention [64], moving beyond the limitation of discontinuance of service or relationship. However, as AI continues to improve in speed, efficiency and availability, the competitive advantage for individuals and organisations will be centred on sustainability. Ultimately, organisations that invest hugely in the dynamism of human-technology interaction may control the market, irrespective of the level of analysis.

4.5. Research framework

The categorization under this section was based on the theories and models found in the publications reviewed. Due to the infant area of AI, most of the studies did not use theories or frameworks (e.g. [57]) but tried to propose a supporting theory. However, technology acceptance (TAM) was predominantly used to examine the acceptance, performance and human integration with AI. Other frameworks underlying AI include fuzzy logic, self-determination theory, critical theory and anthropomorphism theory.

Interestingly, two themes (i.e. autonomy and learnability) emerged from the conceptualization of the research framework on AI. To begin with the autonomy of AI, these theoretical themes comprise publications (e.g. [2,4,65]) that seek to provide the autonomic behaviour of AI based on the human and social experiences. The scope dimensions of these frameworks for studying AI refer to the autonomous characteristics of continuous growth. The primary articles on autonomous behaviour aim to provide an understanding of the foundational components of AI. Understanding the building blocks of AI facilitates its contextualisation

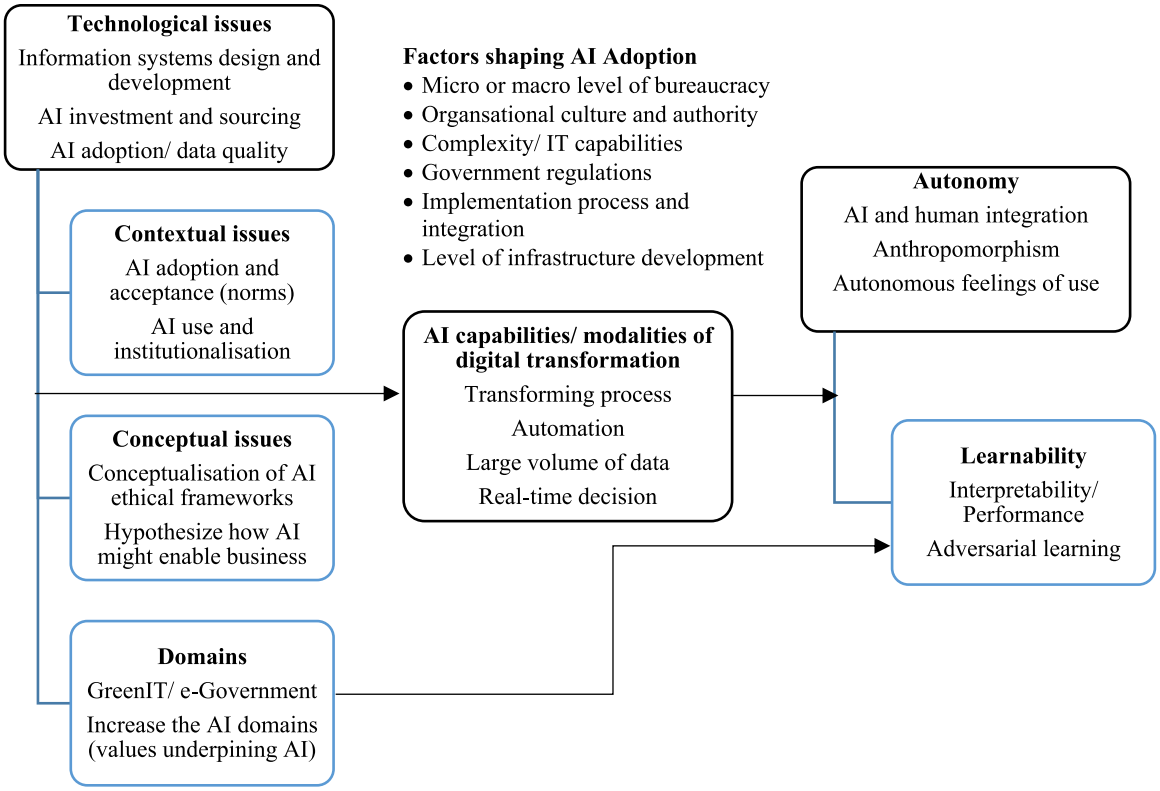

Fig 4. Artificial Intelligence Framework.

Table 8
Future Direction of AI Research.

AI Theme	Challenges with AI	Research gaps	Future research direction
Technological issues	There are growing concerns about the handling of sensitive data in AI systems due to potential misuse and breaches. The prevalence of AI systems is raising more concerns with regulatory frameworks and ethics.	• Most of the AI research focuses on the impact of AI on performance • Most of the current AI research focuses on security issues • Need for regulatory framework and ethical considerations to ensure responsible deployment and adoption	• Future research is required to explore the mediating role of AI's impact on performance e.g. academic or firm performance. • Interestingly, research is needed on how human-AI integration influences human-to-human interaction. To build trust, more research is needed on robust security measures and transparency
Contextual knowledge co-creation issues	Contextually, AI applications can learn unintended and unforeseen behaviours from unstructured and complex data. This can lead to harmful or unintended consequences in societies.	• Limited AI research related to context and generalization. • Many studies have been investigated at the organizational level rather than country level • Contextual and continuous monitoring to refine the AI model is key to its sustainability	• Future research needs to investigate the sustainability of AI per context and compare results e.g. developing vs developed country use of AI. • Further, research should verify AI value and user retention via context • How do we combine different perspectives to build trust and collaboration with AI
Conceptualisation	AI models can act as "black boxes" making it difficult to understand its conceptualization and decision-making processes.	• Few AI research focuses on the theoretical dimensions of AI due to its infancy • Limited studies on LLMs performance compared to traditional chatbots in delivery outcomes	• Future research is required to test new research frameworks and also explore integrative approaches to develop new ones to enhance our understanding of AI's future directions
Domains	AI applications and data required have the potential to grow. However, there are issues with data storage, processing and analysis of infrastructure needed to manage the growth of AI (i.e. the domain of AI is showing an ever-increasing flow)	• Most of the AI research focuses on the various domains of AI and how it can be applied • Also, AI's ability to predict future events and outcomes is still an open research agenda	• Future research is required to venture into new unexplored domains like sustainability and green IT. • Future research is required to advance our knowledge of how domain models differ from AI-tailored solutions
General recommendation for businesses		• The potential of AI workforce disruption and ethical issues requires an improved learning outcome, increased efficiency and research advancement • Discussing the future of business operation's best practices, challenges and opportunities • Embrace individual changes, analytics and learning preferences and value the role of humans • Investing, recruiting and retaining employees who can design, and model AI-tailored solutions to business goals	

and fosters growth. The underlying contextual meaning of these frameworks is that AI permeates almost all aspects of human and social experiences.

The second half of the models and theories underlying AI research comprises of knowledge-based view, social present theory, unified theory of acceptance and use of technology (UTAUT), social response theory (SRT), social cognitive theory (SCT) and uses and gratification theory (UGT). The emerging theme from this research framework is the learnability of AI. This theme comprises articles (e.g. [56,66,67] that show the predicative and learnability characteristics of AI. Given the infant area of AI, it has become important to explore human-driven data analysis, the structure of data, adversarial learning and the interoperability of AI. The next section provides more insight into the theoretical dimension of autonomy and learnability of AI. Table 6 shows the research frameworks and the corresponding theoretical advancement of AI.

4.6. *Theoretical advances of AI*

From the literature review, two main frontiers of AI were identified to advance the theoretical understanding of intelligence and to explore AI's future capabilities – i.e. AI is emerging. Contemporary AI, which continually drives the boundaries of computational capabilities to tackle increasingly intricate decision-making challenges, distinguishes itself from earlier iterations in two primary aspects that significantly affect organizational learning in dealing with AI's potential: autonomy and learnability. The discussion follows as summarized in Table 6.

4.6.1. *Autonomy*

Recent advancements in AI exhibit a propensity to operate autonomously, making decisions and taking actions in the real world that yield tangible consequences, frequently occurring not only without human intervention but also beyond human awareness [57]. For example, Chatbots powered by AI can engage in conversations with users, answer questions, and provide assistance without human operators – using natural language processing to understand and respond to user inquiries [24].

4.6.2. *Learnability*

Learnability is the machine's ability to refine or improve automatically through data [74]. From its inception, the foundational principle in AI has been autonomously enhancing performance through data and experience, and we now have a firm grasp of the core principles in both supervised and unsupervised learning [74]. However, recent advancements in fields like deep learning and reinforcement learning have become achievable primarily because of the vast availability of big data [75]. The enhanced learning capabilities of AI now allow it to excel in more intricate decision-making scenarios, such as tasks involving audio, speech, object recognition, and natural language processing [75,76]. For example, Language models like GPT-3 can learn from a massive amount of text data and adapt to understand and generate human-like text – to become better at tasks like language translation, text summarization, and even creative writing.

4.6.3. *So how does contemporary AI research differ from earlier iterations?*

In the spheres of **learnability**, contemporary AI focuses on enabling dynamic decision-making with emphasis on algorithms that endlessly improve performance with large datasets. Technologies on display include deep learning, neural networks and reinforcement learning that focus on adapting to environmental changes [77,78]. Earlier AI mostly relied on pre-programmed decision trees and rules, thereby limiting its learning potential. Its limitations also included specific tasks and the inability to adjust to new data or unforeseen prompts [79].

Autonomous AI in contemporary AI research in IS focuses on

designing AI applications capable of independent decision-making e.g. self-learning and goal-orientated behaviour [19,41]. While the earlier AI were predominantly reactive systems that responded to predetermined instructions [80]. Thus, human control and oversight dominated earlier AI – and could not plan and execute actions independently. Table 7 shows the impact of contemporary AI and earlier AI on organizational learning.

Overall, the gradual shift towards advanced autonomy and learnability in AI reflects the enhanced computational power and algorithms.

4.7. Towards artificial intelligence framework

From the review, an inductive framework is developed to synthesize the extant knowledge of current AI in an organisational environment. As summarized in Fig. 4, the main themes comprise technological issues, contextual issues, conceptualization and domain issues while the main outcomes of AI is the autonomy and learnability. The linkages from Fig. 4 emerged from the studies analysis and suggest that in a broader organizational or country-level development and use of AI, the four thematic issues may trigger a set of digital transformations initiated by AI which may yield an autonomous or learnability pattern of the institution. In essence, these factors or themes may shape or reconfigure the transformation process of AI; however, real-time learnability results can be directly derived from the various domains. The proposed AI framework aims to help identify research gaps for future investigations. Thus, future research in IS can explore the different interrelationships between the identified themes and outcomes in Fig. 3 to investigate critical issues affecting AI.

5. Implications and future research directions

This review has implications for academics, practitioners and policymakers in AI development and deployment.

5.1. Academics

Across the disciplines, AI is fast transforming research methodologies which has implications for data analysis, research gap identification, literature analysis and personalization of learning and research experiences. This unravels the new discovery of management information systems and innovation. However, it raises concerns about human elements in the research process, ethical data practices and research reproducibility.

5.2. Practitioners

As AI continues to automate roles and activities, there is a need to develop the workforce to adapt and acquire new skills e.g. data analytics and critical thinking to avoid job displacement and social inequalities. To build trust and ensure fairness and accountability, responsible AI practices need to be implemented. To advance the implementation of responsible AI and set standards for data privacy and safety, *Policymakers* need to develop regulatory frameworks. These regulations can address the current challenges of ethical, legal and social posed by AI.

5.3. Limitation

This review only considered peer-reviewed articles, hence falls short of some literature and studies. Also, since the focus was on a selected number of IS-related journals and articles, some studies from non-IS outlets and IS conferences were excluded. Table 8 shows emerging themes, challenges, research gaps, and future research directions of AI in advancing IS research.

6. Conclusion

This article examined artificial intelligence literature through the analysis of 85 articles to determine the current issues and stock of knowledge in AI literature, research methodology, level of analysis and conceptual approaches to identify research gaps for future investigations. The main contribution of this study is the themes' classifications into i) technological issues, ii) contextual issues, iii) domain and application and iv) conceptualisation. *The Technical or technological issues* theme focuses on infrastructure that supports data quality and availability while the *contextual issues* theme encompasses research concerning the socio-technical aspects of AI, including acceptance, adoption, integration, cost and ethics. From the analysis, two main frontiers of AI were identified to advance the theoretical understanding of intelligence and also to explore AI's future capabilities – i.e. autonomy and learnability. The study concludes with an AI framework and research gaps to support the growth of AI in business processes and procedures. As shown in Appendix A, the takeaway from the article summary is the research interest in *security and ethics, business model focus, digital transformation and innovation (reshaping value propositions), platform growth, sourcing AI evolution, continued themes with new framing (IT/AI strategy and alignment), AI autonomy and knowledge creation.* Finally, the researcher hopes this study will spark further exploration in AI research.

CRediT authorship contribution statement

Kingsley Ofosu-Ampong: Conceptualization, Methodology, Writing – original draft.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

Appendix A. Articles by journal publication and research issues

Journal	Some names of authors	Research issues
IEEE Transactions on Industrial Informatics	[17]	AI to explainable AI Security and ethics
Computers in Human behaviour (x2)	[59]	AI-enabled customer experiences Trust-commitment theory and service quality model
International Journal of Intelligent Information Systems	[42]	AI Chatbot Advisory System Platform growth
MIS Quarterly Executive	[5]	AI and social dysfunction Authority reporting
Journal of Data and Information Quality	[19]	Data quality and explainable AI

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Journal	Some names of authors	Research issues
Qualitative Research in Financial Markets	[51]	Robo-advisors Automated online advisory platforms
Journal of the Academy of Marketing Science	[2]	AI and anthropomorphism Service provision; Physical robots
Decision Support Systems (x4)	[81]	Perceived customer autonomy Explainable AI and customer emotions
Business Horizons (x2)	[3]	A framework for diagnosing value destruction potential
	[58]	AI and governance change structure Tailored internal architecture UTAUT, Issues of autonomy
European Journal of Information Systems (x3)	[29]	AI and self-disclosure of personal information Privacy and participation in ridesharing
Artificial Intelligence in Medicine	[35]	Explainability of artificial intelligence in medicine
Journal of Science Education and Technology	[52]	Generative artificial intelligence New business model
Journal of Business Research (x2)	[66]	Resource and knowledge-based view
International Journal of Information Management (x3)	[47]	Intelligent service robots AI trust and culture
Telematics and Informatics (x3)	[48]	Technology acceptance theories AI-based intelligent products
Journal of Information Technology(x2)	[65]	Innovativeness in the digital age
Technological Forecasting and Social Change (x2)	[60]	AI-based technologies Sustainable entrepreneurship
Journal of Strategic Information Systems	[82]	ML value creation; Knowledge creation Task augmentation Human-in-the-loop work configuration Digital/human work configuration
Journal of Internet Commerce (x2)	[70]	AI anthropomorphism Purchase decision in chatbot commerce
Journal of Business Logistics	[53]	Technology acceptance model, artificial intelligence and trust issues
Journal of Intelligent & Fuzzy Systems	[40]	Computer network security and artificial intelligence
Engineering Applications of Artificial Intelligence	[43]	Artificial intelligence Metaverse development
Frontiers in artificial intelligence (x2)	[83]	AI trustworthiness, explainability, and ethics Implicit anthropocentric anthropomorphistic concepts
Communication Studies	[46]	Privacy and machine values
Neural Networks	[75]	Deep learning, reinforcement learning World models
European Journal of Information Systems (x4)	[30]	Responsible AI Dark side of AI
Nature Machine Intelligence	[26]	Skills for physical AI
Academy of Management Review	[57]	Conjoined agency
Information and Knowledge Management.	[22]	AI trust, innovativeness Psychological needs
Journal of Computer Information Systems (x2)	[32]	AI, systemic factors and chatbot sustainability
Journal of Retailing and Consumer Services	[21]	Autonomous vehicles and demographic variables
Computers in Human behaviour (x4)	[31,36]	AI device human-like; Empathy and perceived psychological anthropomorphism AI development with social chatbots
International Journal of Contemporary Hospitality Management	[68]	AI-based chatbots; Hospitality and tourism integration with AI
AI & Society (x5)	[27].	Psychoanalysing of AI – Replika
	[28]	AI policy, ethics, and regulation
Learning and Instruction	[62]	Adaptive feedback AI neural networks Pre-service teachers' diagnostic reasoning
Critical Care	[54]	AI and scientific writing
Information Systems Management (x2)	[20]	AI and governance in businesses.
Expert Systems with Applications	[78]	Explainable AI Intrusion detection in IoT networks Deep learning-based approach
Journal of Service Management	[38]	AI + feeling Customer experience with chatbot
Electronics (x2)	[39]	IoMT + deep CNN; Pandemic diseases AI-based intelligent support system
Electronic Market	[33]	Trustworthy AI
AI and Ethics	[55]	Sustainable AI
Intelligence	[49]	Intelligence level of AI strategy and alignment
Nature Machine Intelligence (x11)	[6]	A new generation of AI
The Innovation (x2)	[41]	AI and scientific research
International Journal of Electrical, Electronics and Computers	[34]	AI modelling in ERP Cloud-Based System
Science China Information Sciences	[84]	3rd generation AI

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