



Artificial Intelligence in Automated Information System Design and Optimization: A Systematic Review

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ABSTRACT

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automated information system, artificial intelligence, systematic review, PRISMA, IoT, industry 4.0, optimization, neural network, machine learning

This article presents a comprehensive review of contemporary solutions for designing and optimizing automated information systems (AIS) (for example, a shipping company). Motivated by the advent of emerging technologies and the industry's escalating demands for enhanced efficiency, flexibility, and connectivity, recent trends and advancements in the design of automation systems have garnered significant attention. Notably, however, a considerable gap exists in the literature, as most studies concerning AIS do not provide a systematic and structured analysis of these emerging solutions. This research endeavor aims to address this gap by systematically analyzing and evaluating the most recent approaches, methods, and technologies available for designing and optimizing AIS, whilst assessing their effectiveness and potential for future applications. The study employs the PRISMA method for a systematic literature review to accomplish this objective. Key databases utilized include Google Scholar, CrossRef, Scopus, Web of Science, and Directory of Open Access Journals, along with specific search strings such as "automated information systems", "Artificial intelligence in AIS", "Machine and deep learning in AIS", and "Neural networks in AIS". The inclusion criteria focused on research published in the last ten years (2015-2025) to capture recent advancements. Only peer-reviewed journal articles and professional sources were considered for their reliability and quality, while English-language publications or translations were required for consistency. Non-peer-reviewed materials, editorials, book chapters, notes, and government reports citing data primarily from before 2019 were excluded. This screening process employed a four-step classification process to categorize the reviewed literature into themes and meta-analyses. The review is intended to identify recent trends and advancements in AIS design, evaluate which optimization techniques are most effective in enhancing the performance and efficiency of AIS, explore the challenges and limitations encountered in the implementation of innovative solutions in AIS development, and highlight emerging solutions, concepts, and methods that may pave the way for future research agendas. The literature review identifies artificial intelligence and intelligent automation as predominant themes within the field of AIS.

1. INTRODUCTION

Automated systems design is revolutionizing how businesses operate in our ever-evolving landscape. Automation, in its many forms, has become deeply embedded in nearly every facet of society, serving as an essential component of contemporary business operations [1]. It has transitioned from being a luxury to an absolute necessity. Automated systems, built to enhance efficiency and drive

innovation, are now indispensable for organizations striving to stay competitive and succeed in today's rapidly evolving global environment. Through the design of automated systems, businesses can optimize processes, minimize errors, and adapt swiftly to changing demands, ensuring they stay ahead in today's fast-paced world. An automation system is an integrated framework engineered to execute tasks and processes efficiently with minimal or no human involvement. It combines hardware and software components to ensure high

efficiency, accuracy, and consistency across both industrial and non-industrial operations. Automation systems span a wide range of technologies, from basic programmable logic controllers (PLCs) to advanced robotic and AI-driven systems [2].

Automation technologies are widely utilized across manufacturing, automotive, shipping, and logistics industries to optimize processes, lower labor expenses, and enhance overall product quality. An automated information system (AIS) is a compilation of hardware, software, or both that automates communication, documentation, reporting, processing, and storing of information, and typically features a front-end. Whether the goal is to streamline processes, enhance decision-making, or optimize business operations, advanced artificial intelligence (AI) solutions are here to help. The demand for robust IT process automation grows as organizations handle complex IT environments with diverse Software as a Service (SaaS) tools, users, and vendors.

Information technology (IT) process automation tools play a key role in improving business process efficiency. The first step in process optimization is optimizing routine processes. With the right software solutions, not only can routine processes be automated, but complex operations can also be streamlined and simplified.

Automated workflows - meaning the execution of modelled processes and the reduction of error likelihood. Ensure that workflows are designed to be efficient, time-saving, and secure. IT process automation tools minimize manual workload, enabling employees to focus on higher-value tasks while providing centralized management of diverse automated operations through a single, unified interface.

In contemporary corporate environments characterized by rapid change, swift and informed decision-making is crucial for success. Over the past few years, there has been a surge in AIS research, driven by growing interest in AI's potential to revolutionize economies.

However, most studies on automated information systems lack a systematic, structured analysis of emerging solutions. Embracing IT process automation tools empowers IT teams to champion operational excellence, optimize resource utilization, and AIS design and optimization, such as the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).

Despite advancements, uncertainties and concerns persist related to the influence of emerging technologies on the design and optimization of AIS. The existing literature does not provide a comprehensive understanding of how AI tools and technologies are utilized in designing and optimizing these systems, with only a handful of studies offering a general overview [3].

This study intends to fill a gap in the literature by thoroughly and systematically analyzing and evaluating the latest approaches and technologies for designing and optimizing AIS, identifying their effectiveness and potential for future applications.

The goals of the review are to: 1) identify the most recent trends and advancements in automated information system design; 2) identify the optimization techniques that significantly enhance the performance and functionality of AIS; 3) determine the obstacles and limitations that arise when implementing innovative solutions in AIS development; 4) acknowledge emerging solutions, ideas, and methods that can provide an agenda for future studies.

The findings will enhance the understanding of AI and its application in developing solutions for AIS design and optimization, benefiting both academia and industry, as well as providing a better experience and deeper insights into current and future trends of AIS for IT businesses and industries, highlighting the opportunities and challenges for advancement and a competitive edge in AIS.

The advancement of digital transformation processes will ensure the uninterrupted and continuous development of production processes, leading to increased business profitability in the face of the dynamic modern environment. This is impossible without the development and implementation of integrated information systems for decision support (DSS). Ultimately, digital transformation, aided by DSS, will provide a mechanism for extracting relevant and up-to-date information, enabling the development of adequate solutions and the practical implementation of new management methods. The introduction of DSS enables the expansion of the range of different technologies, allowing for the presentation and transmission of information in digital form using a single database. Previously, such information circulated mainly in the field of information and communication technologies; now, practically all information is in electronic (digital) form.

The basic concept of the digital economy - the hyper-connectivity of subjects and objects of modeling - is presented in this method through a single database. A new concept has been developed, digital technology is a cost-effective new activity, the next step in the development of the voluntary and business environment. It appears that the digital economy business model of companies (Google, Amazon, Alibaba, Airbnb, Uber) was initially inspired by the use of additional digital technologies, which is the basis of their activities. An information modeling method is presented to generate a database for the effective management of a company's work.

2. LITERATURE REVIEW

2.1 AIS revolution

The use of automated information systems spans from early mechanical calculators and punch card systems to modern AI-driven systems (see Figure 1) [4], evolving from simple data processing to complex decision-making, knowledge management and knowledge discovery in databases (KDD) [5].

The 17th to 19th centuries saw the development of mechanical calculators and the introduction of punch card systems for data processing [6].

The mid-20th century witnessed the emergence of early computers, such as ENIAC and UNIVAC, which enabled more sophisticated control functions and faster calculations.

Expert Systems, developed in the 1970s and 1980s, aimed to capture and apply the knowledge of human experts in specific domains [7, 8].

Machine learning (ML) and data mining technologies (1990s-2000s) enabled computers to learn from data and identify patterns, resulting in more intelligent systems.

Big data analytics, as seen in the 2010s, can store and analyze massive amounts of data, becoming crucial for understanding trends and making predictions. AI and deep learning (2010s-Present) are revolutionizing information systems, enabling them to perform tasks that were once thought to require human intelligence. From mechanical

tabulators to AI-powered systems, AIS has transformed the

way to organize, manage, and utilize information [9].

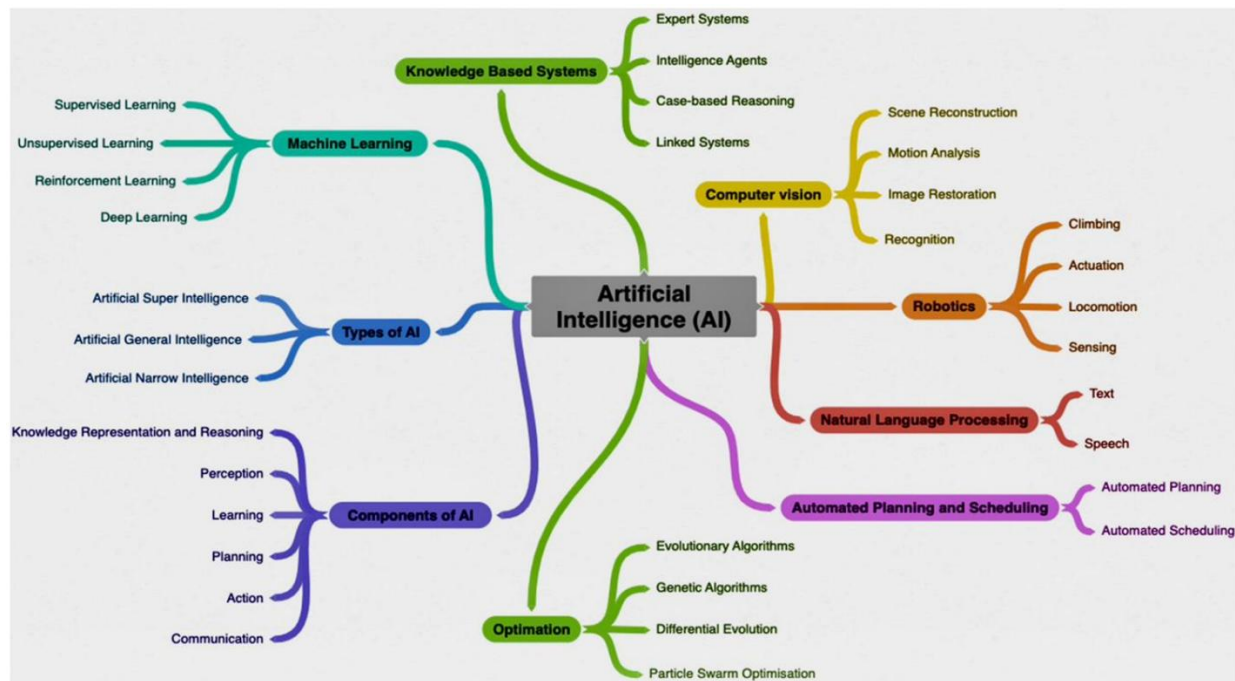


Figure 1. The components, types, and subfield of AI

2.2 Current state of research

This section reviews existing literature on artificial intelligence (AI) applications across various sectors, identifying key themes, contributions, and research gaps.

2.2.1 Overview of AI in information systems

Collins et al. [10] comprehensively analyzed the literature concerning artificial intelligence within information systems research.

Their methodological approach identified 1,877 research studies, with ninety-eight categorized as the primary studies. They summarized the principal themes, emphasizing those pertinent to the research.

The investigation elucidated three primary contributions: 1) the current research indicated the significance and impact of AI; 2) the research agenda delineated the practical significance associated with the deployment of AI, and 3) the potential avenues for future scholarly investigations into this rapidly evolving field.

2.2.2 AI in the construction industry

Employing the PRISMA methodology, Regona et al. [4] studied the possibilities and obstacles of adopting AI in the building industry. The outcomes of the review indicated that 1) AI offers significant advantages during the preparation phase, as the completion of building projects is based on accurate forecasting of events, risks, and costs; 2) the key opportunity in implementing AI is the reduction of time spent on recurring tasks, achieved through the use of big data analytics and the improvement of operational procedures; and 3) the foremost challenge in implementing AI on construction sites pertains to the fragmented nature of the industry, which has led to complications in data acquisition and retention.

The study's findings provide valuable insights for various stakeholders within the construction industry regarding the opportunities and challenges of AI adaptability, thereby

contributing to an increase in market acceptance of AI practices.

2.2.3 Innovation in information and communication technologies (ICTs)

Using analytical and bibliographic methods, Rebenok et al. [11] conducted a study that explored the scientific literature on the development of information and communication technologies (ICTs). Furthermore, comparative, logical, and linguistic approaches were employed to enhance the analysis.

A range of methodological strategies, including abstraction, idealization, deduction, induction, synthesis, and information analysis, as well as systemic and structural methods, were applied to examine and process the data. The research effectively determines key conceptual frameworks of digitalizing socialization, concentrating on the core issues.

2.2.4 AI systems in small businesses

Orlov et al. [12] reported the innovation of an AIS for a cafe, designed to meet the expectations of small-scale businesses. The project focused on the network equipment and the information design.

The AIS utilized the PostgreSQL 15 Database Management System (DBMS) to deliver essential functionalities for the efficient operation of a coffee shop, including a user-friendly feature lookup, digital shopping, and transaction processing.

Additionally, the application reduces staff demands by automating numerous tasks that employees previously handled.

2.2.5 AI in healthcare

In the healthcare sector, Tan et al. [13] utilized an automated system that combines a deep recurrent neural network with a multitask deep neural network to develop and optimize broad-spectrum psychiatric medications. This innovative approach enables the development of a unique chemical composition with intended effects across different targets. They reported that this method could serve as an effective tool for developing

broad-spectrum compounds, ultimately achieving the targeted response in treating complex neuropsychological conditions.

2.2.6 Educational management systems

Meanwhile, to enhance the efficiency of a university in the Republic of Kazakhstan, Abishov et al. [14] conducted a study on the transition from localized subsystems of university management to an integrated Automated Information System. This new system aims to encompass various aspects of the educational process, automate administrative and business operations, and streamline financial management while providing crucial support for decision-making across all university domains. In the long run, implementing this AIS is expected to promote coordination among universities in Kazakhstan, integrate their information infrastructures, and connect them to the global educational information landscape.

2.2.7 Digital transformation in supply chains

Tazhibekova et al. [15] investigated the impact of digital transformation on supply chains during the COVID-19 crisis in Azerbaijan and Kazakhstan, highlighting common trends and differences among these countries. The findings revealed that inadequate supply chain management is correlated with the scarcity of applications for digitalization. A systematic literature review was also conducted on emerging trends and future research directions related to mobile technology in agriculture [16]. This review analyzed the current trends and anticipated research directions regarding the use of mobile technology in agriculture from 2014 to 2024.

2.2.8 IT implementation in industrial management

A study titled "Investigating the Relationship between Efficiency Improvement and IT Implementation among Employees of Industrial Management Organizations" was conducted within companies in Tehran, as referenced in the reference [17]. This research aimed to explore the correlation between IT implementation and innovation within the industrial management sector in Tehran.

The statistical population for the case study consisted of employees from the Tehran Industrial Management Organization.

The findings indicated a positive relationship between enhancements in personnel efficiency and the implementation of IT systems. Notably, the factors associated with efficiency improvement and innovation were found to have the strongest correlation with the implementation of AIS [18].

This thematic organization exposes several trends in AI and IT research, highlighting significant gaps in implementation, integration, and practical applications across various sectors, including education, healthcare, and beyond.

Research gaps identified in the literature emphasize the necessity for automated information systems capable of adapting to functionality and variations in environmental conditions without compromising accuracy or efficiency. Additionally, there is a lack of studies focused on integrating these systems with the latest solutions, like the IoT and quantum computing, which could enhance automated and real-time data processing.

Further research is also needed to explore the flexibility and expandability of automated information systems across various applications. Current studies do not adequately discuss how the narrow scope of these systems can be adapted to varied environments, thereby restricting their usefulness in different operating conditions.

Hence, this article reviews optimization methods that enhance adaptability, efficiency, and decision-making in automated information systems, emphasizing the transformative role of AI and digital twin technologies. Ultimately, this review highlights digital twins as foundational intelligent, sustainable IT systems that incorporate advanced optimization strategies to enhance adaptability and operational resilience.

This positions optimization algorithms and digital twins as key drivers in the future of automated information systems [19]. Emerging technologies and industry demand for increased efficiency, flexibility, and connectivity drive the latest trends and advancements in automation system design. One significant trend is the incorporation of Industry 4.0 principles and Internet of Things (IoT) technologies, enabling seamless connectivity and data exchange between devices and systems [20].

2.3 Existing methodologies and techniques used in AIS

Generative AI is among the most exciting advancements in AI technology. Unlike traditional AI, which focuses on analyzing data and making decisions, generative AI can produce new data. AI-driven chatbots have grown increasingly sophisticated, enabling them to conduct conversations that feel nearly human.

They can handle various tasks, from customer support to sales inquiries, allowing human employees to dedicate their efforts to more complex challenges. Furthermore, AI-enhanced cybersecurity solutions utilize machine learning and AI to detect unusual activities and even forecast potential threats before they materialize.

Enterprise Resource Planning (ERP) consolidates various functions into a unified and cohesive platform, including finance, human resources (HR), and supply chain management. However, AI-powered ERP systems do more than manage data; they also make intelligent decisions. By incorporating AI into ERP solutions, tasks can be automated and optimized for enhanced efficiency. Big data analysis [21] and AI algorithms can predict trends, identify inefficiencies, and recommend improvements.

AI-driven data analytics harness the power of artificial intelligence to analyze data, identify trends, and generate insights, transforming raw data into actionable information for improved decision-making. Cloud-based AI services enable businesses to utilize advanced AI capabilities without the need for costly hardware or extensive IT infrastructure. A significant advantage of these cloud-based solutions is the swift and seamless deployment of machine learning models.

Additionally, integrating the IoT with AI enables organizations to collect and analyze vast amounts of data from interconnected devices, thereby enhancing operational efficiency and creating new opportunities. A prominent application of IoT and AI integration can be found in the manufacturing sector. By employing IoT devices to collect data from machinery and equipment, companies can leverage AI to analyze this information and make real-time adjustments to their operations.

2.4 Innovative optimization techniques in AIS

The future of system design optimization appears highly promising, particularly with the emergence of technologies such as AI, ML, and quantum computing. Consequently, the

innovations are poised to fundamentally transform the optimization of systems, rendering them more innovative and efficient. AI and ML techniques will be progressively utilized to analyze vast data sets and extract pertinent insights. Furthermore, automation facilitated by AI is expected to streamline numerous system management tasks.

Optimization algorithms will be pivotal in ensuring the efficient and safe operation of autonomous systems. The scope of optimization will encompass critical areas, including route planning, resource utilization, and decision-making.

Moreover, quantum optimization algorithms are anticipated to address intricate optimization challenges remarkably. Logistics, supply chain management, and pharmaceutical drug discovery will likely experience significant advancements. Techniques such as evolutionary algorithms will enable the simultaneous optimization of divergent objectives.

2.5 Innovative solutions in AIS development: Challenges and limitations

Despite its numerous applications and advantages, the existing automated information systems have challenges. Generally, digitalizing information assets introduces cybersecurity risks, which also pertain to AIS. Cybersecurity measures must be consistently updated to identify and address these security threats. While AIS can transfer data between various tools and software, integrating all programs is not always seamless. Transitioning to information management systems can be significant, especially if existing platforms are incompatible with AIS. Upgrading these systems to accommodate AIS often requires retraining staff and facilitating their adaptation to the new processes, which can initially be capital-intensive and logistically complex.

Moreover, not all operations necessitate automation. Automating that function may not be economically viable if an AIS complicates simple, repetitive tasks. Integrating advanced systems with current IT infrastructure demands considerable time and financial investment.

A decade ago, artificial intelligence primarily executed straightforward, algorithmic decision-making processes, a capability known as algorithmic decision-making automation. Early examples of this include the operation of robotic arms and factory assembly lines. While rules-based AI tools proved effective in specific contexts, they lacked the flexibility and scalability required for broader business applications.

These systems operated on a predetermined set of rules, and as the complexity of tasks increased, so did the number of necessary rules, ultimately leading to systems that were not scalable. Addressing these challenges requires innovative solutions, such as developing more robust and adaptable algorithms and creating specialized hardware that can function across various environments.

Research gaps identified in the literature emphasize the necessity for automated information systems capable of adapting to functionality and variations in environmental conditions without compromising accuracy or efficiency. Additionally, there is a lack of studies focused on integrating these systems with the latest solutions, like the IoT and quantum computing, which could enhance automated and real-time data processing.

Further research is also needed to explore the flexibility and expandability of automated information systems across various applications. Current studies do not adequately discuss how the narrow scope of these systems can be adapted to

varied environments, thereby restricting their usefulness in different operating conditions.

2.6 Theoretical framework

In its early days, AI's initial application to automate tasks that were previously performed by humans was considered its most significant advantage. Nonetheless, with the rise of generative AI and its various proficiencies, that viewpoint now seems outdated. Although the types of functions that AI can automate have evolved, the core significance of automation remains unchanged.

AI automation has transformed from simple, algorithm-based tasks to advanced models that utilize large datasets to perform functions usually handled by humans. This new wave of AI is known as "intelligent automation," enabling organizations to enhance their IT systems and streamline business processes while addressing complex challenges.

Machine learning, a key area of AI, enables technology to tackle sophisticated tasks such as speech and handwriting recognition, advanced gaming, and medical diagnosis assistance. Deep learning, whose popularity rose in the 2010s, has elevated the degree of sophistication that AI systems can manage to entirely new heights.

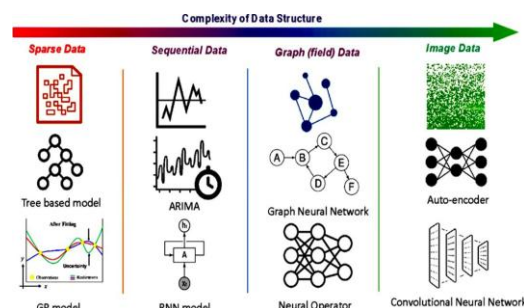


Figure 2. Representation of various data structures

AI has been indispensable in the realm of automation by facilitating the ability of machines to replicate human cognitive functions. AI-powered systems can analyze extensive quantities of data (see Figure 2), generate predictions, and streamline decision-making processes. This technology is currently employed across various industries, including healthcare, finance, and manufacturing, to enhance operational efficiency and effectiveness.

In Figure 2, various data structures are categorized by complexity, ranging from sparse to image data. Sparse data include network diagrams and multi-dimensional scatterplots, demonstrating minimal information points. Sequential data are represented by time-series graphs and flow diagrams, emphasizing temporal progression.

Graph (field) data illustrate interconnected nodes and network relationships, highlighting structured interactions. Lastly, image data displays dense pixel arrays, ideal for visual content analysis (GP = Gaussian process; RNN = recurrent neural network; ARIMA = autoregressive integrated moving average).

3. METHODOLOGY

3.1 What is system design optimization

System design optimization methodically enhances a system's performance, adaptability, dependability, and

serviceability. This process focuses on enhancing operational efficiency while ensuring the system can effectively manage its designated functions with minimal resource consumption and maximal output. By employing rigorous analytical methods and best practices, system design optimization aims to address potential bottlenecks and streamline processes, facilitating an architecture that is robust and agile in adapting to varying demands and conditions.

3.2 Goals of performance optimization in system design

The fundamental objectives of system design optimization encompass reducing latency, enhancing throughput, ensuring scalability, and maintaining robustness. The prioritizing of these objectives can develop systems capable of efficiently managing substantial loads, delivering uninterrupted user experiences, and maintaining resilience in the face of stress. This multifaceted approach to system design is critical for achieving high performance and reliability in modern applications.

3.3 Efficient algorithm selection

Algorithms are the sequential methods or equations used to solve problems. In system design, they are essential in determining how data is handled and tasks are performed, consequently affecting efficiency and performance. A comprehensive approach to system design is essential for achieving high performance and reliability in modern applications. When selecting algorithms, considerations such as time complexity (how execution time increases with input size), space complexity (the amount of memory utilized during execution), and resource usage (the extent to which algorithms minimize resource consumption while maximizing performance) are all considered.

3.4 Scalability considerations

Scalability refers to a system's capacity to accommodate increased load without sacrificing performance. It involves ensuring that a system can effectively grow and manage heightened demands. In today's rapidly evolving digital landscape, scalability is essential. A system that lacks scalability will likely face challenges with elevated traffic, resulting in sluggish performance and potential downtime.

To address scalability issues, various strategies can be employed, including leveraging distributed systems to spread the workload across multiple servers, utilizing load balancers to evenly distribute traffic and prevent any one server from being overwhelmed, and increasing the number of machines or upgrading the capabilities of existing ones.

3.5 Methodological approach

Systematic reviews are a cornerstone in evaluating literature, providing a structured and comprehensive approach to synthesizing existing research. They are designed to minimize bias and enhance the reliability of findings through rigorous methodology. Systematic reviews aim to compile all pertinent research on a particular subject, ensuring no major studies are missed.

This comprehensive evaluation is crucial for establishing a solid foundation for further study and practice. By adhering to systematic review guidelines, researchers can ensure their

reviews are replicable and transparent. This methodological rigor is essential for the credibility and applicability of the findings in real-world scenarios.

Systematic reviews synthesize quantitative and qualitative data, providing a balanced view of the existing literature. This synthesis highlights trends and patterns and identifies gaps in the current research landscape. While systematic reviews are invaluable, they are not without limitations. The process can be time-consuming and resource-intensive, often leading to delays in publication. Additionally, the rapid pace of research can render reviews obsolete shortly after publication.

Researchers are increasingly turning to automation tools that streamline the systematic review process to mitigate these challenges, thereby enhancing efficiency without compromising quality. The study employed a three-stage methodological approach, following the PRISMA guidelines. In the planning stage, research objectives were established to address the questions, relevant keywords were identified, and inclusion and exclusion criteria were set.

The primary focus is to identify recent trends in automated information systems and effective optimization techniques for enhancing their performance and efficiency, and to determine the challenges and limitations in implementing innovative solutions in AIS development. While research papers highlight various tools in the design of automated information systems, there is a notable lack of systematic, structured reviews of the latest solutions in the design and optimization of information systems.

3.5.1 Data extraction

The initial search criterion was developed using the following key concepts: utilizing databases like Google Scholar, Crossref, Scopus, Web of Science, and Directory of Open Access journals, along with specific search strings such as "automated information systems", "Artificial intelligence in AIS", "Machine and deep learning in AIS", and "Neural networks in AIS" to gather pertinent articles published from 2015 to 2025.

The findings from the literature review established keyword co-occurrences for AI in AIS design and optimization. Key AI algorithms were frequently mentioned in peer-reviewed journal articles: neural networks [22], fuzzy cognitive [23], genetic algorithms [24], computer vision [25], and recurrent neural networks (RNN) [26]. These keywords delineated the parameters of the research domains and provided an overview of artificial intelligence technologies presently employed in automated information systems.

The keyword search was conducted in April 2025, yielding 351 results that matched the search criteria. After the initial search, all identified articles were imported into Zotero, a reference management software, to eliminate duplicates. This process allowed for the identification and removal of 59 duplicates. After eliminating duplicates, 292 papers were retained, including academic articles from sources outside university library databases and blog posts.

This preliminary search did not limit specific time frames. Furthermore, selection criteria were created to reduce the number of articles and simplify the review process for screening purposes (see Table 1).

The second stage involves executing the review. Pertinent articles were looked for in April 2025. Over the past decade, the application and adaptation of emerging solutions in designing and optimizing AISs have significantly increased.

The initial search yielded 292 articles, which were then

filtered to include only those published between January 2015 and April 2025, resulting in a reduced number of 76. Each selected study was evaluated based on predefined questions to clarify research aims and methods.

Table 1. Selection criteria

S/N	Inclusion Criteria	Exclusion Criteria
1	peer-reviewed journal articles published in the last ten years	duplicate records
2	Conferences	books chapter
3	focus on the latest solutions in designing and optimizing information about automated systems.	government reports
4	complete text that can be accessed on the internet.	not AIS-related
5	released in the English language	non-relevant research objectives
6	industry reports	non-peer-reviewed publications editorials

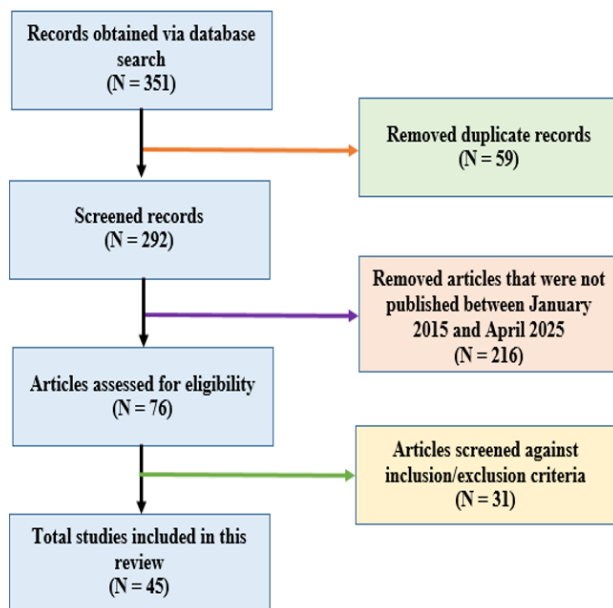


Figure 3. The selection process of relevant studies uses the PRISMA methodology

The titles, abstracts, and keywords from the other 76 publications were evaluated based on the selection criteria (refer to Table 1), ultimately resulting in a final count of 45 relevant articles (refer to Figure 3) [27].

3.5.2 Quality assessment

In this part, the quality of the papers that fulfilled the criteria was evaluated based on five key points.

A three-tiered scale was used for this assessment (1: "Yes"; 0.5: "Partial"; 0: "No").

Consequently, each study could receive a score ranging from 0 to 5 points, with a higher score indicating a greater readiness to tackle the research questions. The evaluated aspects include:

- (1) Are the research objectives articulated with clarity?
- (2) Has the study been structured to fulfill these objectives effectively?
- (3) Are the methodologies evaluated in the study clearly delineated?

(4) Are the procedures for data collection described in sufficient detail?

(5) Do the findings contribute meaningfully to the existing body of literature?

To arrive at this final number, each study was scored on a scale from 0 to 1 based on its responses to quality assessment questions, with a minimum threshold score of 3 points required for inclusion in the review.

3.5.3 Analytical techniques

In the third stage (reporting), 45 articles were analyzed via descriptive techniques, specifically explanation building and pattern matching.

These screening processes aimed to evaluate the selected articles based on predefined categories, allowing for an assessment of similarities and differences. A four-step process was employed to classify the reviewed literature into themes and meta-analyses.

The first step involved identifying existing methodologies and techniques used in AIS within the reviewed literature.

The second step focused on determining the optimization techniques that most effectively enhance the performance and efficiency of AIS.

The third step addressed the challenges and limitations of implementing innovative solutions in AIS development.

AI technologies were grouped into three subset themes: "machine learning" (N = 38), "neural networks" (N = 27), and "deep learning" (N = 8). These themes were subsequently evaluated in comparison to other peer-reviewed studies.

4. RESULTS

4.1 Common overview

The annual growth of publications is presented in Figure 4, indicating a notable interest in the topic in 2025, which underscores the significance of this research.

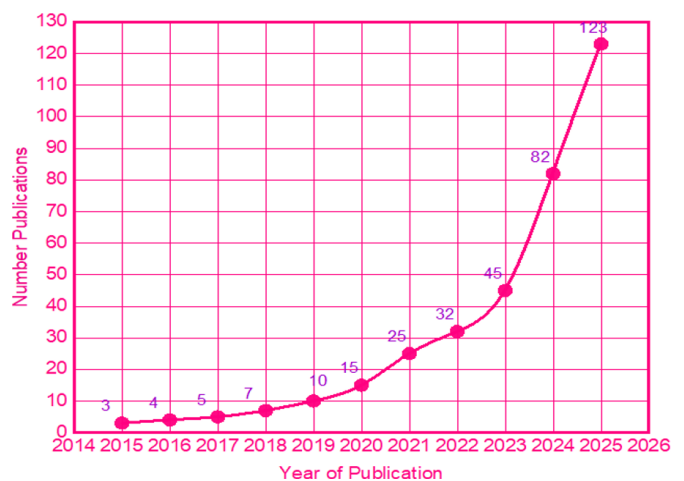


Figure 4. Allocation of items according to year of publication

The number of publications has consistently increased from 3 in 2015 to 123 in 2025, demonstrating a growing scholarly attention to advancements in the design and optimization of automated information systems.

The publication dates indicate an increasing interest in AI within the AIS domain, as 53% of the 45 articles were

published in the past five years. Many of these leading articles focus on the healthcare sector ($N = 27$), indicating a considerable application in medical care [28].

Additionally, there is a notable interest in the construction industry ($N = 10$). However, research on services remains limited ($N = 5$), along with a few articles covering other areas ($N = 3$), as shown in Figure 5.

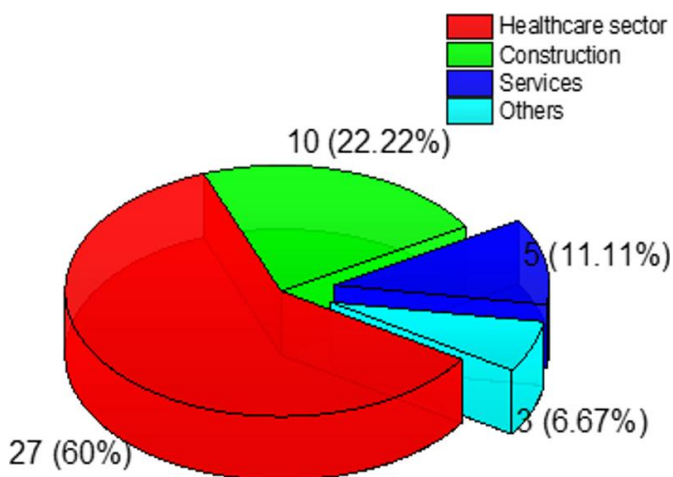


Figure 5. AIS publications according to sectors

Based on the number of reviewed articles ($N = 45$), the general view was that advancements in AI, IoT, edge computing, quantum computing, and other emerging technologies drive the latest trends in the design of automated information systems.

4.2 Key findings

The study also reveals that the optimization techniques often employed to improve performance and efficiency in automated information systems were segmented into data structure optimization, algorithm optimization, system design optimization, database optimization, network optimization, and monitoring and profiling.

The review articles also highlighted that future system design performance optimization trends will utilize AI and ML, autonomous systems for running optimization algorithms, edge computing, quantum computing, and multi-objective optimization techniques, such as evolutionary algorithms, able to optimize multiple conflicting objectives simultaneously.

The key challenges most frequently identified include: 1) the highly specialized nature of AI applications, which require continuous algorithm training to identify patterns effectively; 2) issues related to incompatibility with current IT systems and processes; 3) the ongoing need for investment in AI platforms to maintain up-to-date and accurate data.

Additionally, other concerns encompass security, privacy, and the integration with existing systems.

The literature review identified artificial intelligence and intelligent automation as dominant themes of AIS. Also highlighted were advances in AI and ML, as well as the increasing importance of human-computer interaction, as emerging trends in AIS.

However, despite increasing interest in AI, several identified gaps exist in the current literature, including limited knowledge of AI in information systems and a lack of systematic reviews.

This review addresses these gaps utilizing the PRISMA systematic review technique to highlight and advance knowledge in the latest solutions in the design and optimization of AIS.

The reviewed literature highlighted the effectiveness of various optimization approaches in AIS. Data-driven methods, including machine learning and genetic algorithms, were employed to analyze AIS data and improve decision-making processes [29-31].

By examining factors that influence port times, such as container flow management, these approaches enhance port performance, resulting in greater efficiency, cost reductions, and improved customer satisfaction [32].

Statistical modeling, cluster analysis, and network reconstruction were employed to analyze traffic networks, facilitating the identification of traffic patterns, optimization of traffic flow, and enhancement of port performance [33, 34]. Integrating emissions models with AIS and employing data-driven approaches to optimize shipping routes and speeds resulted in significant reductions in greenhouse gas emissions.

Statistical modeling, cluster analysis, and semantic-based route clustering are often employed techniques in route optimization using AIS data, which can substantially decrease fuel consumption, lower emissions, and improve travel time for shipping companies [35-37].

Eventually, the effectiveness of different optimization approaches in AIS depends on the specific application, data quality, and implementation context. Significant efficiency, safety, and sustainability improvements could be achieved by combining multiple approaches and leveraging AIS data.

5. DISCUSSION

The systematic review highlights a growing emphasis on technological solutions that incorporate AI-driven algorithms. Recent advancements in automated information systems focus on AI integration, multi-objective optimization, and systematic design methodologies to enhance efficiency and adaptability.

This study illustrates the data generation and storage process essential for successfully integrating AI into AIS. It is anticipated that the IoT will significantly impact the adoption of AI within these systems, as it relies heavily on accurately sourcing data and developing new data models.

The frequency of emerging methodologies and techniques was assessed by counting the instances of commonly discussed topics across the 45 reviewed papers. Additionally, keywords from these papers were analyzed to identify the prevalence of key findings.

The results emerging from this systematic review on AIS demonstrate the effectiveness of the PRISMA methodology in synthesizing existing research on AIS to identify trends and patterns, gaps and challenges, and evaluate the effectiveness of different AIS solutions, technologies, or approaches.

This systematic review of the latest solutions in designing and optimizing AIS research and practice can inform decisions and policy-making.

Generative AI emerged as a prominent trend in 2023, as highlighted in McKinsey's trend report outlook for 2024. The report indicated that interest in Generative AI surged, with nearly a 700 percent increase in Google searches from 2022 to 2023, accompanied by a notable rise in job listings and investments.

Established technologies, such as cloud computing [38], edge computing, and advanced connectivity, are now more widely adopted, often serving as enablers for emerging technologies. This report aligns with the findings of this review.

The advantages and benefits of AIS are already well established in the existing literature [39, 40] and align with the conclusions of this review.

However, a careful and more cautious optimism regarding the future projections and impact of AI-driven AIS is recommended, as reported in the studies [41, 42].

Large foundational models, such as large language models (LLMs), are increasingly being incorporated into enterprise software for various applications, including chatbots, advertising, and drug discovery. This trend is expected to continue, with the expansion of AI capabilities.

Growing awareness of generative AI has sparked increased interest, investment, and development in AI technologies, including robotics. Advances in AI are introducing more sophisticated robots, driving innovation, and a wider range of applications. There is an increasing number of automated information systems worldwide, in organizations ranging from automotive and shipping to pharmaceuticals, aerospace, electronics [43], hospitals, banks, airports, and defense, among others.

Even with challenging market conditions in 2023, continued investments in frontier technologies present substantial potential for future growth in enterprise adoption [44, 45]. Since 2022, generative AI (gen AI) has emerged as a notable trend, seeing a significant rise in interest and investment in this field. This increase opens up innovative opportunities across interconnected areas, such as robotics and immersive reality.

5.1 Limitations of the study

This study acknowledges several limitations:

- (1) the research scope inherently constrains the paper;
- (2) the limited number of databases (only 5, not including ScienceDirect, IEEEXplore, Scholar Semantic, etc.) utilized restricts the breadth of the review;
- (3) potential selection bias for selecting research articles, such as the use of more easily accessible publications published in English and a limited search strategy;
- (4) the number of research articles used for this study is limited in number and may not be representative of the whole scenario as such.

The limited search strategy may result in the omission of some relevant studies, particularly those not published in open-access journals, which could potentially lead to a distortion of the results and conclusions.

Moreover, depending solely on academic publications can limit the practical applicability of the results, as such studies frequently emphasize theoretical frameworks or controlled environments that may not reflect the real-world challenges encountered by industry professionals or policymakers.

Additional literature reviews are necessary to broaden the existing findings and enhance our understanding of emerging solutions in the design and optimization of AIS.

6. CONCLUSIONS

This systematic literature review presents a comprehensive synthesis of contemporary advancements in the design and

optimization of AIS.

This endeavor involved rigorously identifying 45 primary studies from 351 pertinent articles published over ten years (2015 - 2025) and analyzing them concerning the following:

- (1) existing methodologies and techniques used in AIS in the reviewed literature;
- (2) what optimization techniques are most effective in improving the performance and efficiency of AIS;
- (3) challenges and limitations of implementing innovative solutions in AIS development.

This review has established that some of the leading existing methodologies and techniques used in AIS, as presented in the reviewed literature, include Generative AI, cloud computing, and edge computing.

Furthermore, the latest trends and advancements in automation information system design and optimization are driven by industry demands and emerging technologies, such as machine learning, quantum computing, and evolutionary algorithms, for increased efficiency, flexibility, and connectivity [46, 47].

Also highlighted in this review are the challenges and limitations of implementing innovative solutions in AIS development [48, 49]. Some of these include the scalability and interpretability of AI models, flexibility, capital-intensive operations, and cybersecurity risks [50].

A noteworthy trend is the integration of Industry 4.0 principles with IoT technologies, which enable seamless connectivity and data exchange among devices and systems.

Furthermore, AI and ML algorithms are being progressively incorporated into automation systems, enabling autonomous decision-making, predictive analytics, and adaptive control.

A significant conclusion arising from this study is the imperative to:

- (1) expand the volume of scholarly research on artificial intelligence, particularly about algorithms and systems;
- (2) build upon existing cumulative knowledge;
- (3) research into AI within the context of AIS remains largely underexplored.

While a significant volume of literature discusses AI to some degree, there appears to be a lack of a thorough overview summarizing the current understanding of AI within AIS.

This research examines the current body of knowledge on AI in AIS. It has resulted in one of the few systematic reviews in this field, providing a structured examination of the dominant trends and existing shortcomings.

The study sheds new light on the field by leveraging emerging solutions and their associated value for AIS. Several knowledge gaps exist concerning AI research and information systems, so AIS researchers and professionals need to deepen their understanding of the socio-technical aspects of AI and emerging solutions [51].

This systematic review of the latest solutions in designing and optimizing AIS research and practice can inform decisions and policy-making [52].

Future studies should focus on applications specific to various industries and the legal, moral, social, and ethical ramifications of implementing AIS.

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