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Hsu Cheng Fang(Author) *Shu Te University*	**A study exploring the key factors that influence foreign tourists' decision to re-visit Taiwan by AHP**

Abstract

This study aims to investigate the key factors influencing foreign tourists to revisit Taiwan. The Analytic Hierarchy Process (AHP) technique was adopted as the research method to establish a model for evaluating the best treatment and disposal techniques. Expert opinions were incorporated into the selection of criteria, and AHP was used to determine the weights of these criteria, which were then ranked. By using the AHP model, quantitative weights were calculated to determine the priority of alternative options. This study provides a simple framework to address complex models. Due to international lockdowns caused by the pandemic, tourists from various countries were restricted, leading to a surge in post-pandemic travel. The rapid economic recovery saw countries offering various travel incentives to attract tourists. The model from this study indicates that factors considered by foreign tourists when deciding to revisit Taiwan include travel resources, quality of travel services, cultural experiences, and transportation convenience. The study found that travel resources and service quality are the most important factors influencing foreign tourists to revisit Taiwan, proving that rich travel resources and high-quality services are the primary drivers in attracting foreign tourists.

Keywords: AHP Analytic Hierarchy Process, travel decision-making, foreign tourists, Taiwan, revisit rate

Introduction

Taiwan, with its diverse travel experiences, has become an ideal destination for foreign tourists. Firstly, Taiwan boasts a rich cultural heritage, exemplified by the National Palace Museum in Taipei, which showcases thousands of years of Chinese historical artifacts, allowing visitors to gain a deep understanding of Eastern culture. Secondly, Taiwan's natural landscapes are

beautifully varied, including the majestic mountain scenery of Alishan, the spectacular gorges of Taroko National Park, the scenic lakes and mountains of Sun Moon Lake, and the beach and coral beauty of Kenting. These natural attractions offer endless exploration opportunities for outdoor enthusiasts. Additionally, Taiwan's culinary culture is a major highlight. From night market snacks to Michelin-starred restaurants, Taiwan offers a rich variety of food options to satisfy the palates of international tourists. Night markets, such as Shilin Night Market and Raohe Night Market, are especially noteworthy, gathering various traditional snacks and serving as the best places to experience local life and food culture. The friendliness and warmth of the Taiwanese people also provide tourists with a welcoming travel environment. Moreover, Taiwan's convenient transportation system allows visitors to easily reach major attractions with a comprehensive public transport network. Taiwan also hosts numerous festivals and religious events, such as the Taipei Lantern Festival, the Sky Lantern Festival during the Lantern Festival, and The Mazu Pilgrimage in March. These unique cultural activities attract a large number of foreign tourists.

Literature Review

The factors influencing foreign tourists to revisit a destination have been a focal point of research in the tourism field. In recent years, with the rapid development of the tourism industry and deepening cultural exchanges, scholars have conducted more in-depth studies on these factors and proposed new perspectives and insights.

Firstly, tourism resources are considered one of the key factors attracting tourists to revisit. Recent studies, however, have emphasized the importance of resource diversity and sustainability. For instance, Gao & Wang (2020) pointed out that destinations with a rich diversity of resources are more likely to attract repeat visits from tourists, as they can switch between different attractions and activities, maintaining interest and novelty (Wei, 2017; Cheng & Huang, 2020). Secondly, service quality plays a crucial role in influencing tourists' decisions to revisit. Many recent studies have highlighted the importance of personalized service and customer experience. For example, Yang & Zhang (2021) emphasized that providing personalized services and customized travel experiences can significantly enhance tourists' satisfaction and loyalty (Wei, 2017; Wang, 2020; Gao & Wang, 2020).

Additionally, price is considered an important factor influencing tourists' decisions to revisit. However, recent studies indicate that price is not the only consideration. For example, Li & Huang (2020) stated that tourists are willing to pay higher prices for better quality and service experiences. Convenience of transportation and safety are also seen as important factors. With the continuous development of global transportation networks, it has become easier for tourists to reach various destinations. Meanwhile, the safety conditions of a destination are a crucial consideration for tourists. A safe and stable environment can enhance tourists' confidence and satisfaction (Wang, 2020; Gao & Wang, 2020; Yang & Zhang, 2021). Finally, Yang & Zhang (2021) also focused on the impact of promotional activities and a touristfriendly environment on tourists' decisions to revisit. Effective promotion can increase the visibility and attractiveness of a destination, while a friendly tourism environment can make tourists feel comfortable and relaxed.

Methodology

This study employs the Analytic Hierarchy Process (AHP) as the primary methodology. AHP, introduced by Saaty in 1980, is a structured and powerful decision-making tool renowned for its ability to handle complex multi-criteria problems. It aids decision-makers in making informed choices both qualitatively and quantitatively. The unique feature of AHP is its ability to determine the relative importance of criteria and handle both quantifiable and intangible factors through pairwise comparisons. Although AHP is widely applied in multi-criteria evaluations, its application in considering the interdependence and feedback among criteria is still insufficient in the existing literature. The pairwise comparison and synthesis process in AHP play a critical role in selecting the best techniques and optimizing costs.

The AHP methodology typically involves four key steps: decomposing the decision problem into goals and alternatives, quantifying these goals and alternatives through pairwise comparisons, synthesizing these goals, and incorporating subjective inputs to derive the priority of alternatives (Bertolini, Braglia, and Carmignani, 2006). In AHP, a nominal scale is primarily used for pairwise comparisons, which is derived from a basic five-point scale into a nine-point scale. The maximum eigenvalue (λmax) is used to evaluate the consistency of the comparison matrix A, which should ideally be equal to the number of criteria (n) to achieve perfect consistency. However, in practical applications, pairwise comparison matrices often deviate from perfect consistency. The difference between λmax and n is called the consistency deviation, indicating

the degree of inconsistency among the criteria. To assess consistency, the consistency index (C.I.) can be divided by the random index (R.I.) to calculate the consistency ratio (C.R.). Consistency is considered satisfactory when the C.R. is less than or equal to 0.1 and close to 0.

Discussion and Results Analysis

In the context of this study, a two-tier research framework was constructed using the AHP method (as shown in Figure 1), seamlessly integrating insights from the literature review and expert opinions. This innovative framework serves as a structured and systematic approach to handling complex decision-making scenarios, considering various criteria and their intricate interrelationships. The first tier of the framework includes a comprehensive literature review, which plays a crucial role in identifying and defining the key objectives and alternatives to be evaluated. By drawing from existing research, the researchers gained valuable insights into the problem's background and the factors to consider in the decision-making process. This knowledge laid a solid foundation for the subsequent steps of the AHP methodology.

The second tier of the framework includes expert opinions and pairwise comparisons. In this stage, domain experts were involved to provide their insights and expertise. Through a series of pairwise comparisons, these experts assessed the importance and relationships between the identified objectives and alternatives. This process allowed for the quantification of subjective judgments, making them suitable for rigorous analysis within the AHP framework. Integrating these two tiers into a single framework marks a significant advancement in the application of the AHP method. It enables decision-makers to leverage a rich knowledge base derived from both academic research and practical experience. By addressing the multifaceted nature of the decision-making scenario, this approach enhances the robustness of the decision-making process, promoting more informed and effective choices.

In summary, this study adopted the AHP methodology as a
methodological approach to tackle complex decision-making scenarios with multiple criteria. The structured framework of AHP, including pairwise comparisons and expert opinions, enhances the ability to make informed and prioritized choices considering both qualitative and quantitative aspects of the problem. The combination of literature review and expert insights within the AHP methodology, in a two-tier framework, represents an innovative approach to advancing more effective and informed decision-making. This holistic approach provides a valuable tool for

decision-makers across various fields, enabling them to address complex problems and make optimal choices.

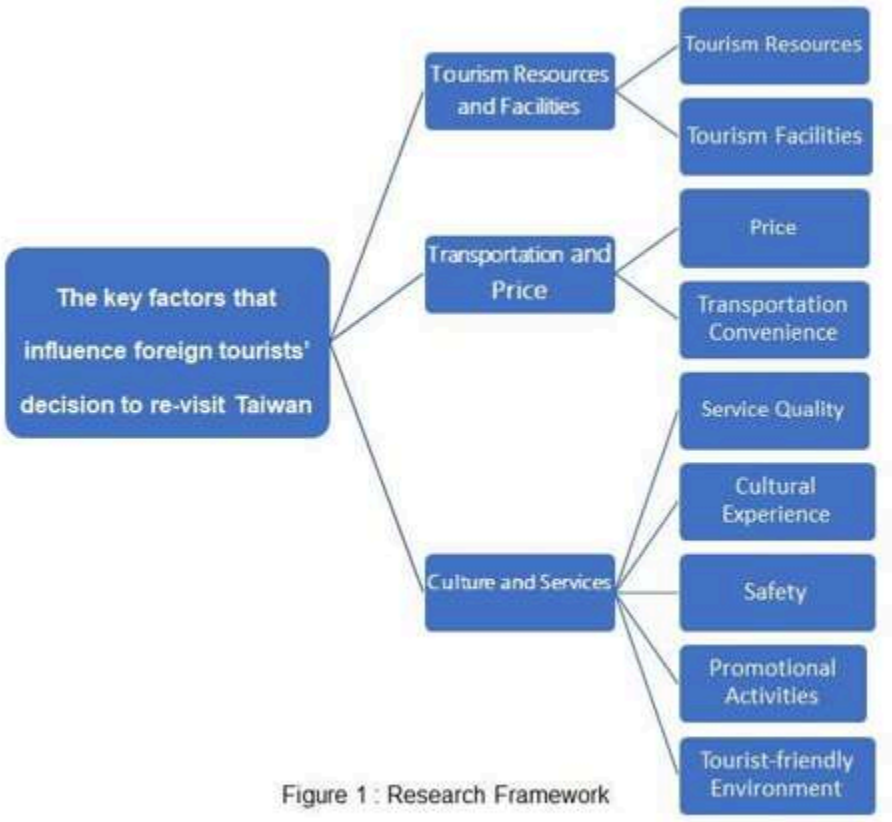

Figure 1 : Research Framework

According to the weighted results from the AHP study among fifteen experts in the first tier, nine experts prioritize tourism resources and facilities. Additionally, three experts also rank cultural aspects and services as their second choice. As a result, the study finds that the combined average of tourism resources and facilities reaches the highest point at 0.261, ranking first (Table 1). The findings indicate that factors like culture and service, as well as transportation and prices, are not insignificant. However, high-quality tourism resources and facilities directly enhance consumer travel experiences, leaving them satisfied and with lasting impressions. Moreover, attractive natural landscapes and tourism resources prompt visitors to consider revisiting, thereby increasing the likelihood of repeat visits.

To evaluate the relative priority order of the AHP weighted values in the first tier, each element

within the dimensions of tourism resources and facilities, transportation and prices, and culture and service—the key factors influencing foreign tourists' decisions to revisit Taiwan—were assessed. The results show that tourism resources and facilities are paramount, followed by culture and service in second place. Surprisingly, transportation and prices occupy the last position. This indicates that among the critical factors influencing foreign tourists' decisions to revisit Taiwan, consumers are most concerned about the adequacy and richness of Taiwan's tourism resources, ranking it highest in impact, followed by service quality, while transportation convenience surprisingly has the least impact.

Table 1: The Frist layer of the weight value of AHP results

Level 1	Sum of the averages	Sequence	Level 2	Sum of the averages	Sequence
Tourism Resources and Facilities	0.261	1	Tourism Resources	0.380	1
			Tourism Facilities	0.142	8
Transportation and Price	0.126	3	Price	0.251	3
			Transportation Convenience	0.113	9
Culture and Services	0.202	2	Service Quality	0.343	2
			Cultural Experience	0.172	5
			Safety	0.176	4
			Promotional Activities	0.171	6
			Tourist-friendly Environment	0.149	7

In the second tier of AHP results (Table 2), as assessed by fifteen experts, the rankings show that "Tourism Resources" are the most important, with a research value of 0.380. "Service Quality" follows as second, with a research value of 0.343, while "Price" ranks third at 0.251. "Safety" is fourth with a value of 0.176, "Promotion and Marketing" fifth at 0.172, "Cultural Experience" sixth at 0.171, "Tourism Environmental Friendliness" seventh at 0.149, "Tourism Facilities" eighth at 0.142, and "Transport Convenience" ranks last at 0.113. According to the opinions of the research experts, it is evident that they unanimously agree that the richness of tourism resources is the most crucial factor influencing whether foreign tourists will revisit. Following closely is "Service Quality," which also strongly influences consumer willingness to revisit.

Table 2: The Second layer of the weight value of AHP results

Level 1	Tourism Resources and Facilities		Transportation and Price		Culture and Services				
Lever 2	Tourism Resources	Tourism Facilities	Price	Transportation Convenience	Service Quality	Cultural Experience	Safety	Promotional Activities	Tourist-friendly Environment
Expert 1	0.274	0.265	0.266	0.033	0.029	0.087	0.029	0.029	0.033
Expert 2	0.326	0.239	0.239	0.151	0.204	0.154	0.089	0.033	0.303
Expert 3	0.512	0.014	0.222	0.204	0.326	0.204	0.033	0.431	0.198
Expert 4	0.361	0.069	0.431	0.016	0.356	0.326	0.431	0.029	0.059
Expert 5	0.421	0.249	0.222	0.071	0.510	0.145	0.039	0.089	0.083
Expert 6	0.222	0.145	0.326	0.303	0.512	0.222	0.356	0.441	0.181
Expert 7	0.356	0.021	0.069	0.053	0.233	0.021	0.181	0.131	0.100
Expert 8	0.473	0.069	0.131	0.472	0.326	0.465	0.181	0.259	0.225
Expert 9	0.476	0.121	0.241	0.016	0.444	0.034	0.326	0.029	0.090
Expert 10	0.298	0.326	0.204	0.071	0.510	0.145	0.039	0.089	0.085
Expert 11	0.467	0.259	0.159	0.151	0.271	0.155	0.085	0.154	0.303
Expert 12	0.472	0.053	0.089	0.029	0.467	0.095	0.165	0.431	0.198
Expert 13	0.465	0.045	0.266	0.016	0.326	0.034	0.326	0.029	0.059
Expert 14	0.326	0.107	0.431	0.053	0.452	0.021	0.181	0.131	0.100
Expert 15	0.258	0.141	0.472	0.053	0.181	0.465	0.181	0.259	0.225
Sum	5.707	2.123	3.768	1.692	5.147	2.573	2.642	2.564	2.242
Sum of the averages	0.380	0.142	0.251	0.113	0.343	0.172	0.176	0.171	0.149
Sequence	1	8	3	9	2	5	4	6	7

Conclusion

This study applied the Analytic Hierarchy Process (AHP) to identify key factors influencing foreign tourists' decisions to revisit Taiwan and provided targeted recommendations. It is hoped that these findings and suggestions can assist Taiwanese tourism operators and policymakers in formulating more effective strategies to enhance foreign tourists' satisfaction and revisit rates, thereby promoting the sustainable development of Taiwan's tourism industry. According to the research results, tourism resources, service quality, cultural experiences, and transportation convenience are the primary factors influencing foreign tourists' return visits to Taiwan. Among these factors, tourism resources and service quality are considered the most critical, indicating that rich tourism resources and high-quality services are the primary drivers for attracting foreign tourists to revisit Taiwan.

Based on these findings, this study proposes practical recommendations for tourism operators and relevant policymakers. Firstly, there should be efforts to enhance the diversity and attractiveness of tourist attractions to ensure the sustainable development of tourism resources. Secondly, continuous improvements in service quality across accommodation, dining, guided tours, and other service aspects are essential. Furthermore, enhancing the depth and breadth of cultural experiences will allow visitors to more deeply understand and experience Taiwan's unique cultural charm. Finally, improving transportation convenience to ensure visitors can easily access various tourist attractions is crucial.

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Ghada El Hajjaji(Author) *ENCG Tangier*	**Smart warehouse and immersive technology: systematic literature review**

ABSTRACT

Purpose

The aim of this research is to summarize the relevant literature discussing the use of immersive technologies namely augmented reality (AR), virtual reality (VR), mixed reality (MR) and smart glasses in smart warehouse management in line with industry 4.0.

Design/methodology/approach

We have used Systematic Literature Review (SLR) for peer-reviewed articles (2008-2023). These articles were chosen by using Scopus and Web of Science and Social Sciences Citation Index (SSCI) filter in Web of Science.

Findings

For 61 % of the studied articles, experimentation seems to be the preferred method used by researchers to better understand the consequences of applying immersive technologies. Augmented reality is prominent in the orderpicking activity (10 articles out of 39 discuss order-picking directly), and more specifically, the impact of smart glasses on saving time and leveraging the physical and mental workload. It is worth mentioning that the gamification of warehouses seems to be an emerging concept that allows for a considerable increase in productivity as well as the degree of acceptance when it comes to implementing Augmented Reality in warehousing.

Research limitations/implications

This article's limitation is mainly related to the final number of the chosen articles as well as the lack of software usage to conduct Systematic Literature Review.

Original/value

This paper aspires to serve as a layout for decision-makers to understand the implications of using immersive technologies in order to better embrace their usage in warehouse management. To the best of our knowledge, no research paper has ever investigated the use of immersive technology on warehousing management through a Systematic Literature Review.

Keywords: Augmented Reality (AR), Virtual Reality (VR), Mixed reality (MR), Smart glasses, Warehousing management.

1. Introduction

In the intricate network of global supply chains, warehousing emerges as a pivotal activity that ensures the efficient storage, handling, and distribution of goods (Davarzani & Norrman, 2015; Prananingtyas & Zulaekhah, 2021; Trivellas et al., 2020). As the backbone of organizational logistics, warehouses play a critical role in maintaining the balance between supply and demand, thereby impacting customer satisfaction and operational agility (Malinowska, 2022; Perkumienė et al., 2022; Rehman Khan & Yu, 2019). Conceptually, warehousing refers to the strategic storage and management of goods within a specified area to facilitate their eventual distribution (Ross, 2015). This encompasses a range of activities including inventory management (Atieh et al., 2016), order processing (Boysen et al., 2019), and goods dispatching (Zeimpekis et al., 2007), which are all aimed at enhancing the speed and efficiency of supply chains.

The financial stakes involved in warehousing are substantial, with costs spanning real estate, labor, and technology investments (Rejeb, Keogh, Wamba, et al., 2021). Today, the warehousing industry continues to experience significant expansion, with projections indicating a robust growth trajectory. By 2030, the global warehousing market size is expected to reach up to USD 3043 Billion, showcasing a compound annual growth rate (CAGR) of 14%. This substantial growth is partly driven by the increasing demand for e-commerce fulfillment services, which itself is a rapidly expanding market with a predicted CAGR of 13.9% from 2023 to 2030 (Forkify, 2024).

Despite its significance, warehousing activities grapple with a myriad of challenges such as spatial constraints (Yang et al., 2022), labor shortages (Kanike, 2023), and the escalating demands for faster order fulfillment (Anđelković & Radosavljević, 2018). These obstacles necessitate the adoption of innovative technologies to streamline operations, enhance accuracy, and improve efficiency (Rejeb, Keogh, Leong, et al., 2021). In response to these challenges, technologies such as robotics (Dhaliwal, 2020), the internet of things (IoT) (Kumar et al., 2022), and artificial intelligence (AI) (Pandian, 2019) have been increasingly integrated into smart warehouses, offering solutions for automation, real-time inventory tracking, and predictive analytics. A smart warehouse is defined as a tech-driven facility that stores raw materials and inventory while employing various technologies to monitor and optimize warehousing processes (Das et al., 2023). Unlike traditional warehouses, smart warehouses leverage AI and other technologies to streamline internal mechanisms. Key features of a smart warehouse encompass the capabilities to recognize

and process orders, monitor goods, count inventory, and guarantee that deliveries reach their intended destinations. Consequently, smart warehouses can automate the entire process of moving items from supplier to customer with minimal errors (Das et al., 2023).

The potential of augmented reality (AR) stands out as particularly transformative in smart warehouses because it offers novel approaches to addressing the intricate demands of warehousing (Rejeb, 2019; Rejeb, Keogh, Leong, et al., 2021). By definition, AR represents a technology that superimposes digital information onto the physical world, and it has seen a rapid evolution since its inception (Hořejší, 2015).
With roots tracing back to the 1960s (Lavingia & Tanwar, 2020), AR has transitioned from experimental applications to becoming a critical tool in various organizational activities, including warehousing. By overlaying digital images and information onto a user's view of the real world, AR facilitates a more interactive and efficient approach to tasks such as picking (Schwerdtfeger & Klinker, 2008), packing (Woltering et al., 2020), and inventory management (Mourtzis et al., 2019).

Although immersive technologies are gaining traction across various sectors, their systematic exploration within the warehousing domain remains understudied. This gap is particularly evident in the fragmented nature of current research that fails to collectively assess the practical impacts and potential enhancements AR can bring to warehousing operations. This SLR is crucial as it seeks to consolidate existing research, providing a structured overview that can help pinpoint where AR technologies can be most effectively applied within the logistics sector. By doing so, this review aims to not only advance the theoretical framework of immersive technologies in logistics but also to offer practical insights that can guide future technological implementations. This endeavor is significant because it promises to enhance operational efficiencies, safety, and accuracy in warehouse management, areas that are critical to the success of supply chain logistics. More specifically, the current study aims to answer the following research question:

- What are the current applications of immersive technologies in the realm of warehousing?

This paper aims to present the current state of immersive technologies applications in warehousing practices. Initially, we provide qn overview on warehousing and more precisely, its evolution, importance in the company and the challenges related to it.
The primary focus of our study is on analyzing and synthesizing current research regarding the practical implementations of immersive technologies in warehousing, which demonstrates their

capacity to improve efficiency, accuracy, and safety in operations. Moreover, we aim to construct an overview on the most common characteristics of these applications as a starting point in understanding what their limitations are, as well as understanding what might inhibit companies from adopting them.

2. Conceptual background

2.1. Warehousing

Warehousing is a crucial component of the supply chain that involves the storage of goods and materials until they are needed (Ross, 2015). The primary function of a warehouse is to regulate the flow of products, ensuring that supply meets demand in a timely and efficient manner. This involves a variety of processes, including but not limited to inventory management, order picking and packing, goods receipt and dispatch, and value-added services like product assembly and packaging (Rejeb, Keogh, Wamba, et al., 2021).

Order picking and packing processes represent one of the most labor-intensive and cost-heavy activities within warehousing (Poon et al., 2009). Optimizing these operations can lead to significant efficiency gains (Frazelle, 2016). Strategies such as improving warehouse layout, employing advanced picking technologies, and enhancing workforce productivity play crucial roles in speeding up these processes, thereby reducing operational costs and improving customer service levels. Warehouses today are not limited to traditional storage functions; they increasingly offer value-added services that directly contribute to product enhancement and customization. Ghoumrassi and Țigu (2017) illustrate how services such as product assembly, packaging, and quality inspections enable companies to meet specific customer demands more flexibly and efficiently. These services, conducted within the warehouse, can significantly reduce transportation costs, expedite delivery times, and enhance the overall quality of the final product, thereby adding substantial value to the supply chain. The strategic importance of warehousing extends to its impact on supply chain optimization. According to Christopher (2016), decisions related to warehouse location, design, and operational practices have profound implications for a supply chain's efficiency, responsiveness, and resilience. Effective warehousing strategies can lead to reduced lead times, lower transportation costs, and improved service levels, ultimately offering a competitive edge in the marketplace.

2.2 Immersive technologies

The concept of AR is employed to encapsulate technologies that blur the lines between the physical world and digital enhancements (Rohacz & Strassburger, 2019). It specifically refers to a tangible environment enriched with digital overlays and supported by advanced hardware and software (Cirulis & Ginters, 2013). Unlike Virtual Reality (VR), which crafts a wholly synthetic experience through a sophisticated interface that stimulates multiple senses, AR integrates digital augmentations with the real world, creating a hybrid space where virtual elements enhance physical reality (Burdea & Coiffet, 2003). Tracing AR's historical lineage reveals its inception in the realm of theoretical exploration and experimental innovation. The embryonic phase of AR can be linked back to the 1960s with Morton Heilig's Sensorama, which is an immersive machine that prefigured multisensory engagement (Mealy, 2018). However, the formal articulation of "Augmented Reality" emerged in 1990 through the visionary work of Boeing's Tom Caudell, who sought to refine the assembly of aircraft through digital guidance systems (Janin et al., 1993).

The evolution of AR witnessed a milestone with the University of North Carolina at Chapel Hill's Virtual Fixtures platform in the early 1990s, marking the first operational integration of virtual enhancements in a physical task environment (Livingston et al., 2002). This lineage underscores the transformative journey of AR from conceptual prototypes to sophisticated systems that overlay digital information onto the physical world, offering enhanced interactive experiences. In the context of contemporary supply chains and operational frameworks, AR has emerged as a pivotal technology. Due to their intricate structures and the push towards mass personalization, modern supply chains necessitate adaptive and customizable operational processes (Rejeb, Keogh, Wamba, et al., 2021). The deployment of AR within such environments promises not only to streamline complex logistical tasks but also to foster a dynamic reconfiguration of production lines and workplace ecosystems (Silva & Liyanage, 2019). This adaptability is crucial for supporting the evolution towards specialized production and smart factories, stressing the role of AR in driving digital innovation in warehousing activities and enhancing operational efficiency through advanced technological integration.

2.3. Immersive technologies in smart warehousing

The support AR provides to warehousing activities is multifaceted, enhancing visual communication (Rejeb, Keogh, Leong, et al., 2021), reducing errors, and streamlining training processes (Rejeb, Keogh, Wamba, et al., 2021). In the current academic literature, several studies have examined the potential of AR for organizations. For example, Silva and Liyanage (2019) explore the emerging trend of AR in supply chain management, particularly in warehouse operations within Sri Lanka. The authors suggest that although AR technology is in its infancy in this context, its potential benefits could significantly enhance operational efficiency. Through a mixed-method approach involving a comprehensive literature review, qualitative interviews, and a questionnaire-based survey, Silva and Liyanage (2019) predict a promising future for AR in enhancing warehouse operations despite current technological immaturity. Tsang et al. (2022) focus on the integration of Extended Reality (XR) technologies with IoT in logistics and supply chain operations. According to the authors, XR facilitates immersive visualization to strengthen the connection between humans and cyber-physical systems, underscoring the importance of human-centricity in Industry 5.0.

Furthermore, Puljiz et al. (2018) discuss the incorporation of AR in warehouses automated by mobile, rack-carrying robots. In their study, an AR interaction system is designed to aid human workers in navigating and interacting with these automated environments, demonstrating AR's potential to streamline operations in autonomous warehouses while also pointing out the challenges that lie ahead. Mühlan et al. (2021) present a framework derived from a systematic literature review for the managerial implementation of AR and highlight both technical and non-technical dimensions essential for integrating AR into industrial processes effectively. Similarly, Rejeb's series of studies further expand on the applications and challenges of AR in logistics and supply chain management. For instance, Rejeb (2019) identifies technical, organizational, and ergonomic barriers to AR adoption in logistics. Meanwhile, Rejeb, Keogh, Leong, et al. (2021) and Rejeb, Keogh, Wamba, et al. (2021) both investigate the benefits and obstacles of employing AR and smart glasses in logistics and supply chain management, highlighting areas like visualization, interaction, and navigation alongside the technical and ergonomic challenges. Lastly, Rejeb, Rejeb, & Keogh (2021) explore AR's utility in the food industry and identify key areas where AR can significantly add value, such as process efficiencies, decision-making, marketing, training, and safety.

I. METHODOLOGY

In order to answer this paper's research question, a systematic literature review (SLR) was conducted by analyzing the articles which focused on the implementation of augmented reality in warehouse. The study focused on papers published in the last 15 years (2008-2015) in peer-reviewed and indexed journals while including specific keywords related to warehouse management and immersive technologies (augmented reality, virtual reality, mixed reality, extended reality).

1. Inclusion Criteria

The following list of inclusion criteria was established in order to guarantee a reliable foundation for our article's selection. This latter is limited to those in English since it is considered to be the most frequently used language for scientific research. However, we are well aware that this selection might have inhibited us from discovering other studies with a significant contribution to our research aims. Further selection criteria include choosing both journals and conference proceedings articles in the time period 2008 - 2023 to increase the diversity of the collected information related to the introduction of immersive technologies into warehousing management, which sparked in the previously mentioned period. Furthermore, the articles filtration process limited the chosen article to those related to Business, Management and Accounting to remain in line with the research aim: "*How ready are managers and decision makers to welcome the usage of immersive technologies within the warehousing management?*". Last but foremost, to insure a highly selective list of articles, the filter of Social Sciences Citation Index (SSCI) section in Web of Science (WOS) database was applied.

- Articles in English Only.
- Articles only published in Journals with an inclusion of conference proceedings.
- Articles that are in their final state.
- Articles published in between 2008 and 2023.
- Articles which the research area is mainly (Business, Management and Accounting).
- Articles that are registered under the Social Sciences Citation Index (SSCI) section in Web of Science (WOS) database.

2. Data extraction and synthesis method

The goal behind this paper is to serve as a comprehensive and unbiased synthesis of the existing studies related to the impact that immersive technologies might have on the efficiency of warehouse management. **Table 1** summarizes the primary research results using multiple queries (before applying the previously mentioned filters) in both Scopus

and Web of Science (WOS) databases before formulating the general query.

Query	Results in SCOPUS	Results in WOS
"Smart glasses" AND warehouse	24	14
"augmented reality in warehouse"	5	3
"virtual reality" AND "warehouse"	259	49
"mixed reality" AND "warehouse"	19	10
"Extended reality" AND "warehouse"	2	1

Table 1. A summary of the primary list of the queries used in early article selection phase (no filters applied)

Our intention is to get a preview on the existent studies that highlighted the presence of augmented reality in warehouse management. However, and taking into the consideration the lack of consensus among researchers on each immersive technology's definition, we believe it is best to conduct multiple research queries where each one highlights a specific technology.

Although the primary results show a slight divergence in the number of articles found in the two databases we previously mentioned, it is worth mentioning that scarcity marking the results of the query "extended reality" AND "warehouse" could be considered as an intriguing starting point to conduct future research on the implications of using technologies based on extended reality (XR), which can be particularly challenging since (XR) is located on the extreme end of the virtuality continuum presented by Milgram back in 1994.

3. Quality assessment of selected studies

In order to hold our study impartial, and considering how each database is distinguished by its own specificities in terms of filtering the results it generates, it is wise to outline two distinct filtering schemes.

Table 2 explains the process of article selection process starting from the initial "raw" results found after applying the general research query until the screening phase allowing us to focus on articles in line with the research questions listed above. The general query used to generate the general query used in both Scopus and WOS to obtain the results illustrated on the two figures is as follows:

TITLE-ABS-KEY (("Augmented Reality" OR "AR" OR "Virtual Reality" OR "VR" OR "Mixed Reality" OR "MR" OR "HMD" OR "head mounted display" OR "Immersive technologies" OR "Smart glasses" OR "extended reality" OR "XR") AND ("warehouse" OR

"logistics" OR "Smart warehouse" OR "picker" OR "order picking" OR "supply chain*" OR "green supply chain*"))

Filter used	Documents found in Scopus	Documents found in WOS
General Query	7,402	7,193
Articles only	5,660	5,531
English Only	5,299	5,469
Final articles	5,226	Not applied
Published in the last 15 years	4,420	5,031
Subject Area (Business, Management and Accounting)	157	763
WOS based Index: SSCI	Not applied	567
Top 3 Publishers	Not applied	176
Papers related to warehousing	71	49
Screening	30	12

Table 2. A summary of the filters used to obtain the finally chosen articles

In order to guarantee a higher degree of transparency in the selection process, four (4) filters are used in both Scopus and WOS to maintain a high-quality data extraction. Afterwards, the three (3) following specific filters are introduced to each database.

→ **The (SSCI) filter applied to WOS:** The Social Sciences Citation Index (SSCI) filter is specific to the Web of Science database and is often used in systematic literature reviews to guarantee a selection of high-quality research papers in order to avoid compromising the validity of obtained results and conclusions.

→ **The Top 3 publishers applied to WOS**: Similarly to the previous filter, the top 3 Publishers filter was also employed to guarantee a high-quality selection of articles that helped us narrow our research to 176 articles.

→ **The final articles filter applied to Scopus**: By narrowing down the papers found to 5165 papers after applying the "final articles" filter, it is hoped that our conclusion will solely be based on articles that reached their final phase of

publishing and disregard those which the review process might be ongoing and risks of compromising the foundation on which this study is based.

→ **Subject Area (Business, Management and Accounting):** Although immersive technologies have been used in multiple fields, our research question is mainly related to how managers would perceive their implementation, and more precisely: *what would stop them from investing in using an immersive technology in warehouse management.*

So far, this paper has focused on the primarily results provided by the queries used in both Scopus and WOS and has gradually introduced the data extraction's process with a specific attention to the filters that were used in each database. The following section will dig deeper into the distribution of the found data in terms of the number of publications per year, the geospatial distribution of the authors as well as the distribution of articles according to journals. **4. Descriptive results**

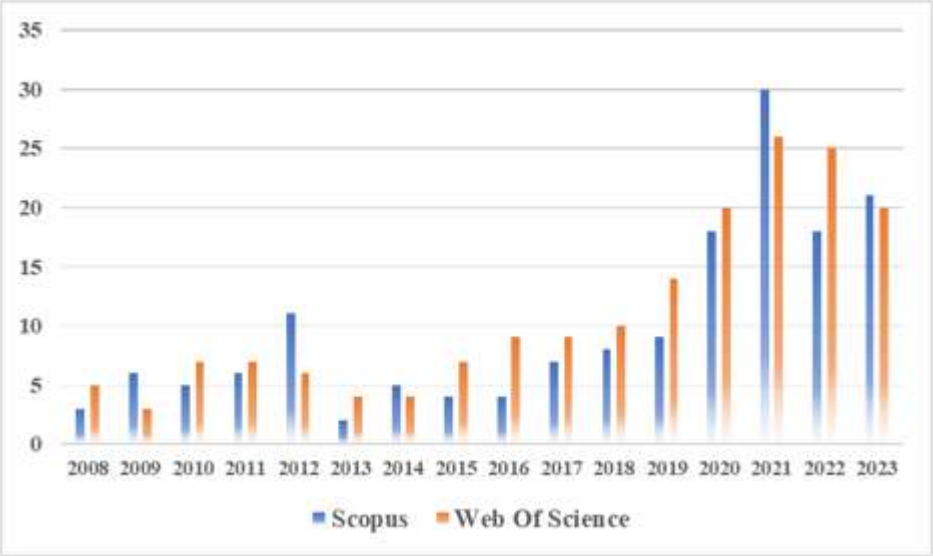

Figure 1. The number of publications per year in both Scopus and WOS

The evolution of the literature related to the application of Augmented reality in warehouse management in the period 2008-2023 shows an increasing interest in the academia community during the period (2019 – 2023). This is particularly reflected in our articles' selection as their recency plays a vital role in founding this paper's conclusions on the most up-to-date knowledge that could be found.

Scopus	
Country	**Number of Authors**
United States	26
China	24
India	22
United Kingdom	16
Germany	11
Iran	7
Italy	7
Japan	6
Pakistan	6
Australia	4

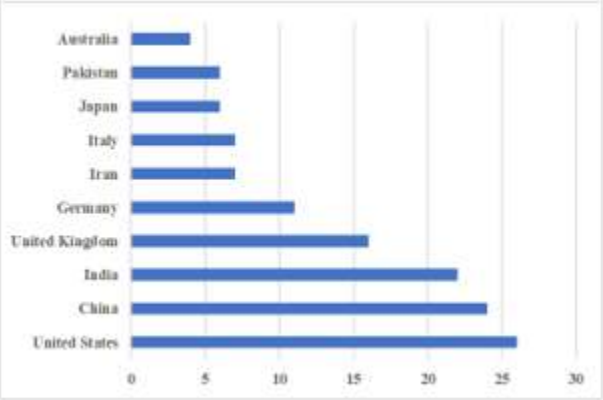

Figure 2. The number of publications per country – Scopus

Web Of Science	
Country	**Number of Authors**
United States	83
China	32
England	27
India	16
Canada	14
Netherlands	13
Australia	12
France	7
Germany	7
Brazil	6

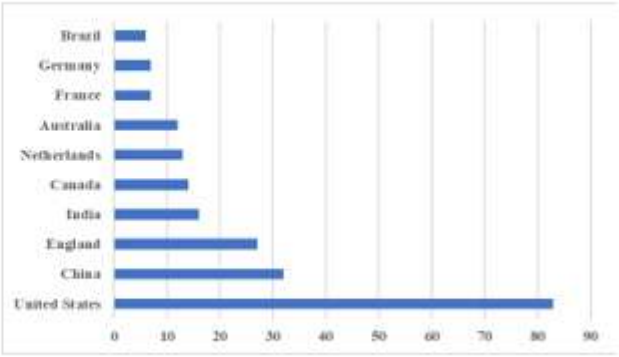

Figure 3. Number of Authors per country – Web of Science

The geographical distribution of the chosen publications analyzed in figures 2 and 3 indicate the top ten (10) nations from which at least four articles originated. According to Scopus database, the highest number of publications originated from US (26), followed by China (24) and last but not least India by a total of (22) published papers. As for Web of Science database, the US is still prominent with (83) publications, followed by China (32) and England (27).

III. RESULTS AND FINDINGS

The screening phase has allowed to maintain a total of 39 articles that were obtained after reading the title, the abstract, eliminating duplicated articles, reading the full text and categorizing them according to research methods and research aims of the selected batch, which were summarized in Table 2.

- **Research method:** With 61 % of the chosen articles, experimentation seems to be the preferred method by researchers to better understand the consequences of applying immersive technologies (especially augmented and virtual reality) which can be easily explained by the recency of immersive technologies. This method remains the most useful to fully understand the benefits of such implementation as well as the dangers and limitations related to it.
- **Research gaps:** The research gaps that have been mentioned vary from understanding how

can Augmented Reality' application help saving time on daily activities of warehousing to assessing the staff's degree of technology- tolerance.

- **Core warehousing activities where AR was applied**: (AR) is prominent in the order picking activity (10 articles out of 39 discuss order-picking directly), and more specifically, the impact of AR-based smart glasses on time saving and leveraging the physical and mental workload of pickers.
- **The gamification of warehouse management:** The gamification of warehouse seems to be an emerging concept that allows for a considerable increase in productivity as well as the degree of acceptance when it comes to implementing (AR) in warehousing. Based on a survey done by (Ponis et al., 2020) to investigate the possibility of implementing an (AR) order picking system with gamification design components. 64% of supervisors and 67% of order pickers agreed that using smart glasses in a warehouse setting with gamification aspects would boost their acceptability. Moreover, 82% of supervisors and 56% of pickers agreed that including gamification into an AR-enhanced order picking solution would significantly promote adoption.
- **The KPIs on which the efficiency of Augmented Reality' implementation was judged:** Another research question that demands urgent attention is: *"to which extent have the current warehousing KPIs succeeded in keeping up with the implementation of augmented reality?*". So far, only two KPIs are prominently discussed in the current literature: Time reduction and visibility of system status (Remondino, 2020).

However, and to the best of our knowledge, no research paper has ever discussed the component of

"emotions" as a make-or-break factor that could have a significant impact on the decision making regarding the adoption of immersive technologies by decision-makers, managers and staff. The "*cautious"* introduction of the term ***Gamification*** can serve as a first step towards shifting the scholars' focus from technical nuances related to each immersive technology and its usage to the psychological and the neurological dimensions of this latter. More precisely, we have noticed an important research gap in the current literature calling for extensive research on the state of mind of warehousing staff allowing us to aspire for a greater understanding on how warehouse workers think, feel and perceive their work environment before and after using immersive technologies.

Article Title	Year	Authors	Research Method	Research Aim
Warehouse-Scale Video Acceleration	2022	Ranganathan, Parthasarathy ;Stodolsky, Daniel ; Calow, Jeff; Dorfman, Jeremy; Guevara, Marisabel; Iv, Clinton Wills Smullen; Kuusela, Aki	Experiment	Presenting the design of a new accelerator—the video coding unit— targeted at warehouse-scale (cloud) video transcoding.
Augmented reality in logistics: Qualitative analysis for a managerial perspective	2020	Remondino, Marco	qualitative analysis	A qualitative analysis is carried on to identify potential uses in this (and related) fields and a managerial perspective are proposed, identifying specific KPIs and heuristics for the three aforementioned areas.
A full shift field study to evaluate user and process-oriented aspects of smart glasses in automotive order picking processes	2018	Murauer, Nela; Pflanz, Nerina	a field study		Analyzing the impact of wearing smart glasses on employees during a full shift?
ARENA—augmented reality to enhanced experimentation in smart warehouses	2019	Murauer, Nela; Pflanz, Nerina	Experimentation		This work presents an environment for experimentation of advanced behaviors in smart factories, allowing experimentation with multi-robot systems (MRS), interconnected, cooperative, and interacting with virtual elements.
Development and evaluation of inspection support system for power distribution facility using AR	2019	Yumbe, Yoshiki ; Yoshimura, Takuma ; Asano, Aiji ; Komoda, Norihisa; Fujiwara, Toru	The questionnaire consists of 17 statements on a five-point scale		Analyzing if AR is effective in improving and equalizing the inspection quality.
Network video technology: Exploring an innovative		Kembro, Joakim Hans;	An exploratory multiple- case study with nine case companies was conducted, including on-		Investigating how modern network video technology could be used to improve different warehouse types

approach to improving warehouse operations	2017	Danielsson, Veronica; Smajli, Granit	site visits, interviews, questionnaires and a workshop.		and operations and how barriers may prevent its implementation.
Real-time Mixed Reality (MR) and Artificial Intelligence (AI) object recognition integration for digital twin in Industry 4.0	2023	Tang, Yuk Ming; Kuo, Wei Ting; Lee, C. K. M.	Experimentation		Discussing the challenges for the warehouse, not only related to the interconnection of machines and devices, but also to integrate these IoT devices with warehouse workers through integrated data processing.
An augmented reality assisted order picking system using IoT	2019	Nagda, Mayank Kumar; Sinha, Sankalp; Poovammal, E.	Experimentation		Analyzing if AR can relieve the cognitive load on pickers by determining the exact information that pickers need to know on each item.
A grey decision-making trial and evaluation laboratory model for digital warehouse management in supply chain networks	2023	Zaman, Syed Imran ; Khan, Sherbaz ; Zaman, Syed Ahsan Ali ; Khan, Sharfuddin Ahmed	literature review analysis		Discovering the most significant factors that disrupt the SC of the ELSD manufacturing industry, and the ability of decision-makers to evaluate the cause-and-effect relationships between selected RFs
Intelligent Warehouse in Industry 4.0—Systematic Literature Review	2023	Tubis, Agnieszka A.; Rohman, Juni	literature review analysis		• Discovering the research directions related to the adaptation of warehouses to the needs of Industry 4.0 and digital supply chains over the last five years (2018–2022)
Study on emergency disposal process and					The implementation of an emergency disposal process to improve response efficiency for abnormal

mechanism for hazardous chemicals storage areas	2020	Li, Ji; Song, Fumei; Bai, Song	Experimentation		situations and typical accidents in hazardous chemicals storage areas.
A scalable wearable AR system for manual order picking based on warehouse floor-related navigation	2020	Fang, Wei; An, Zewu	Experimentation		Arguing the ability of AR to improve the order picking process by using visual instructions.
Application of supportive and substitutive technologies in manual warehouse order picking: a content	2024	Grosse, Eric H.	literature review		A literature review on supportive and substitutive technologies in manual warehouse order picking and investigates the existing state of research in this field.

analysis				
AR-Based 3D Virtual Reconstruction of Brick Details	2022	Shih, Naai-Jung; Wu, Yu-Chen	Experimentation	Comparing brick details in AR and reconstruct the interacted result in the correct relative location.
Possibilities of using augmented reality in warehouse management: A study	2021	Husár, Jozef; Knapčíková, Lucia	Study Field	The presented manuscript points to the possibilities of implementing Smart glasses in warehouse management.
Human intention estimation based on hidden Markov model motion validation for safe flexible robotized warehouses	2019	Petković, Tomislav; Puljiz, David; Marković, Ivan; Hein, Björn	Experimentation	Proposing a Theory of Mind (ToM) based human intention estimation algorithm for flexible robotized warehouses.
Development of augmented reality applications for refrigerated warehouse	2018	Kim, Siku ; Lee, Sangil; Ryu, Kwangyeol; Cho, Gyusung; Kim, Jaesung	Experimentation	The purpose of this paper is to develop AR applications for cold chain management to be able to efficiently manage the refrigerated.
Influences of augmented reality head- worn display type and user interface design on performance and usability in simulated warehouse order picking		Kim, Sunwook; Nussbaum,		Discussing different HWD types and UI designs affect perceived workload, usability, visual discomfort, and job performance during a simulated warehouse job involving OP and part assembly.

	2019	Maury A.; Gabbard, Joseph L.	Experimentation	
Evaluation of the use of smart glasses in IRS logistics	2022	Binar, Tomas; Vasikova, Simona; Safl, Pavel	Experimentation	How can Smart glasses improve problems related to warehousing (Underqualified staff, minimize time choosing and selecting item) based on IRS Integrated Rescue System and AR based Smart glasses
Augmented reality system for object verification in warehouse environments	2019	Križaj, Janez; Perš, Janez; Dobrišek, Simon; Štruc, Vitomir	Experimentation	The paper proposes an augmented reality system for visual object verification that helps warehouse workers perform their work.
Introducing Gamification in the AR-Enhanced Order Picking Process: A Proposed Approach	2021	Bright, Athina G.; Ponis, Stavros T.	Experimentation	Analyzing the influence and the potential of gamification techniques in supporting innovative Industry 4.0- enhanced processes in the contemporary warehouse work ecosystem.
Brief Survey on Industry 4.0 Warehouse Management Systems	2022	Youssef, Albashir A.; El Khoreby, Mohamed Atef; Issa, Hanady Hussein; Abdellatif, A.	literature review	This paper conducted a comprehensive study on all features and parameters of Warehouse Management Systems (WMS), which monitor and optimize warehouse functions. Finally, the paper addresses the main challenges and research gaps to suggest future research for implementing Industry 4.0 in warehouses.
Pick-by-vision: There is something to pick at the end of the augmented tunnel	2011	Schwerdtfeger, Björn; Reif, Rupert; Günthner, Willibald A.; Klinker, Gudrun	Experimentation	Verifying the ability of AR implementation to improve order- picking in a warehouse.
Food Logistics 4.0: Opportunities and Challenges	2021	Jagtap, Sandeep; Bader, Farah; Garcia-Garcia, Guillermo ;Trollman, Hana ; Fadiji, Tobi; Salonitis, Konstantinos	literature review	Revealing how does technology fit within the food industry, in addition to the challenges related to it?

Smart glass based augmented reality for warehouse management	2019	Aruna, A.; Karthikeyan, Sreehari ; Singh, Shivank; Sailesh Kumar, M.	Experimentation	Verifying if smart glasses can reduce the extra effort of inventory management.
A CAD-augmented Reality Integrated Environment for Assembly Sequence Check and Interactive Validation	2004	Liverani, A.; Amati, G.; Caligiana, G.	Experimentation	The ability of Augmented Reality-based assembly evaluation tool allow engineers to interact directly with the assembly operator while manipulating the real and virtual prototype components.
Efficient local path planning algorithm using artificial potential field supported by augmented reality	2021	Szczepanski, Rafal ;Bereit, Artur ; Tarczewski, Tomasz	Experimentation	Analyzing the ability of Augmented Reality to bypass local minimum.
A review on the positive implications of augmented reality pick- by-vision in warehouse management systems	2023	Jumahat, Shaliza; Sidhu, Manjit Singh; Shah, Sharulhizam Mohamad	literature review	• The key findings concerning the prospective advantages of pick-by- vision in WMS. • The positive implications have been overlooked in the literature.
Challenges and opportunities on AR/VR technologies for manufacturing systems in the context of industry 4.0: A state of the art review	2022	Eswaran, M. ;Bahubalendruni, M V A Raju	literature review	The research progress and developments in the AR/VR technologies for product design and evaluation, Repair and Maintenance, Assembly, Warehouse management, Quality control, Plant layout and CNC simulation.
Multi-robot preemptive task scheduling with fault recovery: A novel approach to automatic logistics of smart factories	2021	Kalempa, Vivian Cremer; Piardi, Luis; Limeira, Marcelo ; de Oliveira, André Schneider	Experimentation	How can Multi-Robot Preemptive Task Scheduling with Fault Recovery (MRPF) optimize task scheduling in smart factories?
Augmented reality system to guide operators in the setup of die cutters	2019	Álvarez, Hugo; Lajas, Igor; Larrañaga, Andoni; Amozarrain, Luis ; Barandiaran, Iñigo	Experimentation	This paper describes an Augmented Reality system for the improvement of the manufacturing process in the packaging
Augmented reality applications for warehouse	2005	Mueck, B; Höwer, M; Franke, W; Dangelmaier, W	Experimentation	Does the implementation of AR based picking system improve the workflow and the picking efficiency in warehousing?

logistics				
Augmented Reality in Warehouse Operations: Opportunities and Barriers	2017	Stoltz, Marie-Helene; Giannikas, Vaggelis; McFarlane, Duncan; Strachan, James; Um, Jumyung; Srinivasan, Rengarajan	A series of practitioners' interviews and via an experiment designed using Google Glass.	* What are the opportunities that AR offer to the warehousing? * What are the obstacles that stand between AR and Warehousing?
Augmented Reality for Warehouse: Aid System for Foreign Workers	2023	Albawaneh, Ahmad; Agnihothram, Venkata; Wu, Jiang; Singla, Goutam; Kim, Hyungil	Experimentation	How can using AR (symbols instead of text) help leverage the challenges related to the foreign workers in inventory warehouses?
Augmented Reality System for Multi-robot Experimentation in Warehouse Logistics	2020	Limeira, Marcelo; Piardi, Luis; Kalempa, Vivian Cremer; Schneider, Andre; Leitao, Paulo	Experimentation	This work presents an industrial plant of a warehouse, where augmented reality is used to represent virtual loads to be transported by multiple small mobile robots.
Gender Differences of Cognitive Loads in Augmented Reality-based Warehouse	2021	Yan, Zihan; Shan, Yifei; Li, Yiyang; Yin, Kailin; Li, Xiangdong	Experimentation	How do male and female perceive Cognitive Loads differently in a warehouse where AR is implemented?
Augmented Reality in Warehouse Operations: Possibilities and Dynamics in Sri Lankan Context	2019	De Silva, Prashan; Liyanage, Harishani	qualitative interviews. A questionnaire-based survey	**1.** To find out the warehouse operations that can be enabled by augmented reality applications **2.** To rank potential warehouse operations that can be enabled by augmented reality applications
Warehouse Design and Operation using Augmented Reality technology: A Papermaking Industry Case Study	2019	Mourtzis, Dimitris; Samothrakis, Vasilios; Zogopoulos, Vasilios; Vlachou, Ekaterini	Experimentation	This paper proposes a framework for warehouse design which minimizes inventory cost while keeping a high degree of service by supporting the integration of an AR warehousing system.
Augmented Reality and Gamification to Increase Productivity and Job Satisfaction in the Warehouse of the Future	2020	Ponis, S. T.; Plakas, G.; Agalianos, K.; Aretoulaki, E.; Gayialis, S. P.; Andrianopoulos, A.	questionnaire-based survey	To which degree do individuals accept the introduction of : a) AR enhanced order picking b) Gamified order picking c) AR order picking enhanced with gamification elements

Table 2. The chosen articles: Research aims and used methods

IV. CONCLUSION, LIMITATIONS AND IMPLICATIONS FOR FURTHER RESEARCH

The purpose of this paper was to conduct a systematic literature review that allows for a better understanding of the current state of literature in terms of Augmented Reality implementation in warehouse management. We insisted on introducing multiple filters that were – on one hand - applicable to both Scopus and Web of Science databases, and on the other hand, specific to each database apart. The research design allowed us to narrow the articles selection to a total of 39 final articles in both Scopus and Web of Science (after eliminating duplicate articles found in both databases) for the last 15 years fulfilling the conditions of being written in English and that fall under the Social Sciences Citation Index (SSCI) section in Web of Science

61% of the chosen publications used experimentation as a research technique to understand the usage of immersive technologies, namely augmented and virtual reality. This could be explained by their recency which requires exposing them (the immersive technologies) to a real-world usage in order to understand the impact they could have.

However, this paper is exposed to many limitations that are worth mentioning to guarantee the upmost degree of transparency.

Limitations related to the previously published studies:

- Researchers need to work closely with the users of such technologies to identify the most suitable procedures for augmented reality implementation.
- The barriers related to privacy concerns or the needed skills to use such technologies are considered to be one of the most frequently mentioned aspects that might discourage employees and managers from considering their usage.
- Problems related to the comfort of device users: This is especially related to the headsets used in virtual reality technologies.
- The absence of the psychological and neurological implications of adopting immersive technologies in management and business field.

Limitations related to the core of our study:

- It would be useful to add another layer of categorization by investigating the implementation of AR in different fields. We believe this would help managers be more mindful when taking the decision of adopting (or not) immersive technologies.
- Due to a lack of funding, full-text reading wasn't applicable to some of the articles that charge fees to be downloaded.
- Conducting an experiment in the Moroccan context would've given the study a holistic view by understand the role of cultural context in adopting the usage of augmented and virtual reality.

As a conclusion, this paper allowed for a clearer understanding of the current research gaps related to the adoption of augmented and virtual reality in warehouse and opened the door to promising paths of academic investigation.

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Akinsanya Mary Oluwaseun(Author) *Olarewaju Rotimi William & Co* **Olarewaju Victor Olakunle(Co-Author)** *Louisiana State University*	**The Critical Role of Effective Project Management in Ensuring Successful Audit Engagements in Firms**

Abstract

Effective project management is pivotal to the success of audit engagements, particularly given their time-sensitive, resource-intensive, and meticulously coordinated nature. This paper highlights how structured project management practices—such as thorough planning, risk mitigation, resource optimization, stakeholder engagement, and continuous improvement—serve as strategic drivers that improve audit quality, timeliness, and compliance with standards. By aligning audit processes with organizational and client expectations, firms can enhance the accuracy, transparency, and overall integrity of audit outcomes. The need for "a structured project management approach enables audit teams to manage resources, align with client expectations, and deliver accurate, timely audit reports," thus positioning project management as an essential element in elevating audit effectiveness and fostering long-term client trust.

Introduction

In an increasingly complex and regulated business environment, audit engagements play a vital role in ensuring transparency, accountability, and trustworthiness in financial reporting. These engagements are inherently intricate, involving multiple stakeholders, strict timelines, and high standards of accuracy. To navigate these complexities effectively, firms must adopt robust project management practices tailored to the unique demands of audit processes. As recent research highlights, "effective project management is pivotal to the success of audit engagements, enabling teams to deliver quality, timely, and compliant results" (Bassey & Ibegbulam, 2023).

This paper examines the crucial role of project management in enhancing the success of audit engagements. It discusses how strategic planning, risk mitigation, resource allocation, stakeholder engagement, and continuous improvement serve as essential pillars for effectively achieving audit objectives.

Strategic Planning and Clear Organization

The foundational step towards successful audits lies in meticulous planning. A well-structured plan delineates the scope, objectives, timelines, and resource requirements, serving as a roadmap for the engagement. "Well-structured plans reduce the likelihood of overlooked areas," ensuring that all critical audit aspects are systematically addressed (Ezeh et al., 2024). Utilizing project management tools such as Gantt charts and dashboards enhances visibility, facilitates coordination among team members, and ensures alignment with client expectations and regulatory standards.

Clear communication is crucial during this phase, as it clarifies roles, responsibilities, and deliverables, ensuring a smooth workflow. When planning is comprehensive, it preempts potential issues, saving time and resources in the long run, and sets a tone of professionalism and preparedness that pervades the entire audit process.

Proactive Risk Management and Issue Resolution

Audits are susceptible to various risks, such as data gaps, stakeholder non-cooperation, and regulatory changes, among others. Effective project management involves proactively identifying these risks and establishing mitigation strategies. This shows that "conducting risk assessments and preparing contingency plans for issues like incomplete data or stakeholder noncooperation" significantly enhances an audit's resilience (Ezeh et al., 2024).

The implementation of quality control measures, such as peer reviews and adherence to professional standards (e.g., ISA, GAAS), further safeguards the process against errors or omissions. Continuous risk monitoring enables audit teams to respond swiftly to emerging issues, minimizing disruptions and maintaining the integrity of the engagement.

Optimal Resource Allocation and Time Management

Efficiency is perhaps the most tangible benefit of good project management. Audit engagements are resource-intensive, requiring the coordination of personnel, technology, and time, which

underscores that "progress tracking, stakeholder updates, and issue resolution" are vital components (Ezeh et al., 2024).

By deploying project management software to monitor key performance indicators—such as task completion rates, budget adherence, and timeline compliance—teams can identify bottlenecks early and adjust their approach as necessary. Proper resource management ensures that audit teams are neither overextended nor underutilized, thereby optimizing productivity and reducing costs. Effective time management also ensures audits are completed within stipulated deadlines, thereby satisfying client and regulatory expectations.

Communication, Learning, and Stakeholder Engagement

Transparent and ongoing communication fosters trust and facilitates smoother audit processes. Highlighting that "clear communication and stakeholder engagement are essential for audit success," enabling teams to address concerns proactively and clarify expectations (Ezeh et al., 2024).

Additionally, promoting a culture of continuous learning ensures that each audit serves as a valuable learning opportunity. Documenting lessons learned and incorporating feedback into subsequent engagements can improve methodologies, enhance team skills, and streamline future processes. Engaged clients and stakeholders who are kept informed of progress contribute to a collaborative environment where issues are addressed promptly, and objectives are met effectively.

Strategic Alignment with Organizational and Client Goals

Aligning audit activities with the broader goals of the organization and client expectations ensures that the audit contributes value beyond mere compliance. The importance of "promoting strong leadership and team coordination," along with effective expectation management, is emphasized (Ezeh et al., 2024).

This alignment involves understanding the client's business environment, risk profile, and strategic priorities. When audit teams work closely with clients to understand these elements, they tailor their procedures accordingly, making the audit more relevant and insightful. Such strategic alignment fosters trust and positions the audit as a partner in organizational improvement.

Closure, Reporting, and Continuous Improvement

The final phase of an audit is equally critical. Concluding with comprehensive reporting, debriefing sessions, and lessons learned documentation ensures accountability and lays the groundwork for ongoing improvement. The PDF states that "documenting lessons learned ensures future improvement," transforming each engagement into a stepping stone for higher quality and efficiency (Bassey & Ibegbulam, 2023).

Transparent reporting, coupled with constructive feedback, enhances stakeholder confidence and fosters a culture of excellence. Moreover, analyzing engagement outcomes helps identify process gaps and areas for refinement, ensuring that future audits benefit from the lessons learned from previous experiences.

Conclusion

In conclusion, effective project management is indispensable to the success of audit engagements. It provides the structure and discipline necessary to navigate the complexities inherent in auditing, ensuring that processes are well-planned, risks are effectively managed, resources are allocated optimally, and communication is clear and concise. As the recent research underscores, "a structured project management approach enables audit teams to manage resources, align with client expectations, and deliver accurate, timely audit reports," thereby enhancing the overall quality and effectiveness of audits (Bassey & Ibegbulam, 2023).

By embedding robust project management practices into their audit processes, firms can not only meet regulatory standards but also build trust with clients and stakeholders, ultimately contributing to organizational success and sustainability.

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Iqra(Author) **Hafiz Muhammad Naveed(Co-Author)** *Sargodha University Pakistan*	**Reshaping Human Resource Management in the Age of AI and Global Disruption: Challenges, Ethics, and the Future of World.**

Abstract:

Two opposing forces the quick integration of artificial intelligence (AI) and the beginning of global upheavals, including pandemics, climate disasters, economic instability, and political unrest are radically altering human resource management (HRM). This article offers a thorough, multidisciplinary examination of how artificial intelligence is changing conventional HR tasks, from talent acquisition and performance management to learning and employee engagement, as worldwide disturbances compel a parallel reimagining of HRM as a strategic, ethical, and future-oriented discipline. Using critical thinking and worldwide case studies, we examine developing problems connected to algorithmic bias, data privacy, emotional labor, neurodiversity, hybrid labor, and legislative complexity. The article suggests systems for ethical integration of artificial intelligence in HR, digital literacy development, culturally astute leadership, and resilient workplace ecosystems. Last but not least, it provides forward-looking suggestions for HR experts, business leaders, and lawmakers to help to design an equitable, sustainable, and people-centric future of employment.

Keywords: Artificial Intelligence in HR, Human Resource Transformation, Global Workforce Disruption, Hybrid Work Models, Ethical HR Practices, Future of Work, Neurodiversity and Inclusion and Sustainable Human Resource Management.

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Almas Kiran(Author) *Punjab University Lahore*	**Exploiting New Technologies for Extremism Prevention: Global Approaches, Innovations and Ethics.**

Abstract:

The world, it seems, has become a rather small place, and not always in a good way. The threat of extremism knows no borders anymore. Once upon a time, folks with extreme ideas would huddle together in hidden corners perhaps a dim basement or a dusty attic, away from prying eyes. Nowadays, they gather on social media platforms, sharing sentiments and finding likeminded companions in endless chat rooms. The alarming part is that extremist ideas spread like wildfire; by the time the authorities catch a whiff of what's going on, the seeds of radicalization have already been sown among the intended audience. Now, relying on traditional methods to tackle this swiftly spreading menace is akin to using an umbrella in a monsoon totally ineffective! This is where our friend, Artificial Intelligence, comes into the picture, ready to identify risks and intervene before it's too late, all while picking up on patterns faster than the keenest observer in a village market.

This paper takes a thoughtful stroll through the various technologies already being utilized around the globe to uncover, track, and prevent extremist content across different platforms. It also tackles the pressing question of how to ensure these technologies remain socially responsible steering clear of invading personal privacy or misjudging innocent opinions while also safeguarding the cherished freedom of expression. The goal is to find that sweet spot where ethics and security can coexist harmoniously, without one overpowering the other. By examining Europe's digital moderation efforts, Pakistan's diligent use of local languages, and North America's predictive methodologies, we uncover valuable lessons that could pave the way for future innovations in AI. The conversation has shifted; it's no longer just about what our capabilities are but about how fair and intelligent we can be in our approaches. And there's thick room for much needed laughter and learning in this serious endeavor.

Keywords:- Artificial Intelligence, Extremism, Radicalization, Ethics, Digital Platforms, Predictive Technology, Human Rights, Cyber security, Counterterrorism, Global Security.

Hammam Abdullah Hussein Shaifan (Author) *Emirates International University*	**Enhancing Cybersecurity in Smart Cities Using AI-Based Intrusion Detection Systems.**

Abstract

Smart cities, powered by networked sensors, Internet of Things (IoT) devices, and datadriven city government, are transforming urban life at a fast pace to enhance the quality of life. But these virtual communities are becoming soft targets for sophisticated cyber attacks. Traditional security solutions do not have the ability to discover and react to realtime attacks in real time, especially zero-day vulnerabilities and advanced persistent threats. This paper explores the integration of Artificial Intelligence (AI) with Intrusion Detection Systems (IDS) to enhance the cybersecurity capabilities of smart cities. With the application of machine learning and deep learning techniques, AI-fueled IDS can monitor network traffic, detect abnormal behavior, and react to suspected threats in real time with minimal human intervention. The paper provides a simulation-based case study to illustrate the comparative performance of AI-fueled IDS and traditional systems in intrusion attempt detection in a smart traffic management system. The results indicate a significant improvement in detection levels, lower false positives, and quicker response to threats. The paper concludes with policy implications, implementation challenges, and research directions to create strong, AI-fueled city cyber defense systems.

Introduction to Smart City Threats

Smart cities are urban cities that leverage networked digital technologies—e.g., the Internet of Things (IoT), cloud computing, big data analytics, and artificial intelligence— to optimize and manage the public transport, energy, healthcare, water supply, and emergency services (Sheth et al., 2016). These technologies are intended to enhance operational efficiency, sustainability, and overall quality of life for the population. However, the intense degree of digitalization and real-time information exchange on which these systems are based provides incredible cybersecurity vulnerabilities (Choras et al., 2021).

Since the smart city is constructed using enormous webs of sensors, controllers, and communications infrastructures, it thus becomes an extremely desirable target for all sorts of menace actors, from cybercriminals, hacktivists, and state-sponsored groups. Since smart city networks are not standard IT infrastructures, they are typically made up of heterogeneous, distributed assets, most of which lack strong native security (Gao & Liu, 2020). Since these assets

are interconnected, they may be affected by a compromise of one infrastructure, say the public Wi-Fi or even the cameras, and have access to even more sensitive infrastructure, say the energy or the transport systems control networks.

Several high-profile breaches have already shown the dangers. For instance, the 2018 ransomware attack on the Atlanta municipal network suspended court proceedings, payment of utility bills, police, firefighter, and other municipal services, costing millions to fix (Choras et al., 2021). Just as with smart road traffic systems, to attack signaling settings or sensor values, with consequence of jam or accident, so medical systems throughout smart cities, with networked medical devices, and patient information stored on the cloud, can be attacked by data breaches, by ransomware, with repercussions on the continuity of the business, to say nothing of patient security.

Legacy perimeter-based security, such as traditional firewalls, and traditional signaturebased IDS will typically be powerless to perform this role (Ahmed et al., 2016). Traditional measures are static, reactive, applied on well-delineated, centralized networks, but incapable of finding mature, multi-vector attacks, much less positioned to keep pace with the constantly changing nature of the smart city infrastructure.

To this dynamic security future, the use of Artificial Intelligence (AI)-enabled security technologies, or more specifically, AI-enabled Intrusion Detection Systems, is an excellent approach to overcoming the constraints of conventional defenses. These systems will be able to handle sophisticated information sets, discover subtle anomalies, keep learning by the latest behavior of threats, thereby ensuring a more scalable and resilient platform for the security of the intelligent city (Gao & Liu, 2020).

Traditional vs. AI-Based Security Systems

Historically, Intrusion Detection Systems (IDS) function almost exclusively by the signature-based or rule-based detection paradigm, utilizing available attack blueprints or known threat signatures to detect malicious behavior (Ahmed et al., 2016). Though useful for the detection of known threats, the trend has some built-in weaknesses. Of primary among these is the fact that it cannot detect zero-day attacks—exploits constructed on yet-to-be-named vulnerabilities—and polymorphic malware, which alters code at set intervals to evade detection (Zuech et al., 2015).

Traditional IDS' other significant failure is the reactive mode of operation and continued need for upgrades. For each new threat discovered, there will need to be a corresponding signature created and installed. There is a lapse between the discovery of the threat until systems are aligned to

respond to it. Signature-based IDS also has the possibility of generating manyfalse positives, especially with complex infrastructure deployments like smart cities (Choras et al., 2021).

On the other hand, server-based IDS employ advanced methods through machine learning (ML) and deep learning, and neuron methods to analyze vast volumes of information and learn the aberration behavior patterns (Gao & Liu, 2020). Unlike the traditional, non-updatable non-signature-based techniques, server-based IDS can remain up to date by learning fresh samples and therefore identifying the novelties, the latter being potential indicators of new unseen dangers.

Unsupervised methods such as Isolation Forests or autoencoders are able to identify outliers in data without prelabeling and can be extremely powerful at revealing new attack vectors through intelligent city infrastructure (Li et al., 2018). Supervised methods such as Support Vector Machines (SVMs) are able to be trained upon prelabeled data to separate behavior with extremely high accuracy. Deep learning and recurrent neural networks have been demonstrated to be able to yield high-quality results for intrusion detection through being able to identify sequential patterns in network traffic (Yin et al., 2017).

They scale to enable the AI-driven IDS to oversee high volumes of varied information across the smart city subsystems like energy, security networks, and transportation systems without the loss of integrity or speed (Gao & Liu, 2020). The fact that they predict enables them to respond to threats prior to causing widespread damage.

Case Study: AI-Based IDS Simulation in a Smart City Environment

For the purpose of analyzing the practical applicability of Artificial Intelligence to intrusion detection, a test bed has been established through simulation by leveraging a smart traffic infrastructure installed normally underneath smart city initiatives conducted within cities. The infrastructure included IoT nodes for traffic sensors, controllers, and edge computing nodes, all networked to mimic the complexity of actual infrastructure. The test bed has been instrumented with benign, as well as malicious, traffic flows to indicate normal and malicious behavior (Li et al., 2018).

An artificial intelligence (AI) Intrusion Detection System (IDS) with an anomaly detection strategy that includes an Isolation Forest scheme and a deep autoencoder has been proposed. The rationale for doing so was their superior performance on unsupervised learning issues with limited labeled examples. The IDS was passive with the monitoring of system activity and network traffic, with the detection of nonconsistency with the extracted "normal" behavior. Such anomalies like abrupt signal timing variation, nonnormal packet length, or aberrant communication of the device were sent to the possible intrusion list.

Simulated attacks included fake signal injection, by which the attackers fake traffic light indications to trigger congestion or accident situations, and spoofed device IDs, by which the attacker assumes legitimate sensor IDs to feed the system with fake information. The deep learning-based AI models were trained on time-series information captured from simulated intersections to learn to recognize the baseline behavior for every device as well as communication flow.

For comparison, the classical IDS with rule-based detection ran on the same simulation test bed as the benchmark reference. Though it could identify common attack schemes, it could not identify new variations of attack or subtle anomalies not defined within its signature database. What this thus indicated, thus, was the essential weakness of the static security solutions within the variable settings (Zuech et al., 2015).

Results and Implications

Its detection, with 92.4% detection rates, was excellent even with a false positive percentage lower than 6%. It excelled best, however, with detection on zero-days as well as low-and-slow attacks, for which other detection technologies were not applicable. These findings further verify the benefits of approach-based detections on AI for dealing with variable, evolving end-user threats, particularly on complex smart cities.

Besides, the AI model showed an improvement pattern, continuously improving detection ratios as it acquired new patterns from simulation runs. The conventional IDS, on the other hand, needed to be manually upgraded and could not adapt with unidentified intrusions. This invokes the need for intelligent, data-driven security systems in smart settings where devices and channels are regularly updated.

They constitute a crucial need for the long-term sustainability of the infrastructure of the city. Fast detection ensures the swift response to the events, lowering the downtime as well as the likely damage. What's more, AI-based IDS would also be able to lessen the security personnel workload by filtering out harmless anomalies, so the experts will operate with priority alarms, not spending time on them, often erroneously causing stress (Yin et al., 2017).

Future Recommendations

To achieve the full potential of AI-based IDS for the smart city, a multi-aspect integration approach is recommended. The preliminary integration of blockchain with AI will serve to guarantee the integrity and immutability of the traffic information, thereby deterring manipulation and enabling tracking of malicious behavior. The merged solution strengthens the integrity of the data ecosystem with reference to belief and enables forensic analysis.

Second, one has to investigate federated learning frameworks in order to improve the model's performance while maintaining privacy. By enabling distributed AI models to learn from the decentralized data without exchanging it to a central server, federated learning reduces the risk of the information breach and complies with the regulations of data protection laws like GDPR (Gao & Liu, 2020).

Local government authorities must channel investments into real-time monitoring systems with the ability to handle large amounts of varied information. Regular training for IT professionals, cybersecurity exercises, and information campaigns must become the norm to create a cyber-conscious workforce. Moreover, enhancing the standard operating procedure for cross-domain information exchange among traffic systems, police, and emergency services will help to coordinate the response to cyber attacks.

One would need to perform additional studies for the assessment of long-term performance measures of AI-driven IDS for implementation on live smart cities, to investigate energy-efficient edge node representations, and to design explainable AI methods for enhancing transparency and accountability to humans for automated decision processes (Sheth et al., 2016).

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An Investigation of Road Construction Project Delays in Somalia

Abstract

Somalia has faced many road construction problems since the central government collapsed. Road construction in Somalia suffers from chronic delays that exacerbate infrastructure gaps and stall economic recovery. The government of Somalia lacked the financial capacity to build or maintain roads during the civil war. Consequently, they sought international organizations and governments to finance the main roads, thereby providing access to the people and facilitating travel to their destinations. This study aims to identify and rank the primary causes of road construction delays in Somalia, involving stakeholders through a survey of 55 potential causes. The data was collected from the client/government, consultants, contractors, and external sources. We analyzed the data using IBM SPSS v27, descriptive statistics, frequency, and percentages, and ranked them using the Relative Importance Index (RII). The key findings are inadequate data collection before the design, lack of funding, weather-related issues such as flooding, poor communication and coordination among all partners, political interference, delayed payments, corruption, and security challenges. Based on those results, we highly recommend capacity building for the workers and improving the coordination among stakeholders, adopting a transparent tendering process, and prioritizing the project timeline for seasonal rain to speed project delivery.

Keywords: Road construction, Somalia, delay, stakeholder, relative importance index RII.

Introduction

Background

For nearly four decades, the road construction project in Somalia has suffered from poor maintenance due to the prolonged civil war. Ineffective government institutions, limited financial resources, corruption, and inadequate collaboration among stakeholders have been persistent problems since the central government of Somalia collapsed in 1991. Somalia's road network system has suffered from destruction, a lack of maintenance, and inadequate investment. The Somali government lacks the financial capacity to build or maintain its roads. Consequently, it

seeks international donors to support the financing of the main highway, which is crucial for providing access to people and goods.

Somalia currently has an estimated road network of about 21,830 kilometers, with only 12% paved (MPWR$H FG of Somalia). Most roads, which are gravel or dirt, are in poor condition and highly vulnerable to weather. Major cities like Mogadishu, Baidoa, Galkayo, Garawa, and Hargeisa are poorly connected to rural areas, limiting access to vital services such as markets, health care, and education. Over half of the Somali population lives in rural areas, while the rest depend on others, making rural mobility and trade very difficult. Maintaining roads is essential for boosting trade, improving access to services, and supporting national unity and economic growth. Most road projects are funded by international donors, including the World Bank, African Development Bank (AFDB), European Union (EU), and Qatar Fund for Development.

Many road construction projects worldwide face challenges during their development. Delays are a significant problem and vary depending on the country and the specifics of each project, including scope, type, and ownership. Road construction is a crucial aspect of the construction industry, and it is a common area where project delays often occur, necessitating immediate action. delays in a specific construction project impact both time and money, which are vital to any economy. Time delays and cost overruns typically harm the growth of national economies, resulting in substantial financial losses and hindering the development of the construction industry (Senouci, 2016).

Scope of Research

This research will focus on analyzing the causes of delays in road construction projects in Somalia. The study targets key stakeholders of road construction projects, including the government, consultants, contractors, and external partners. Data will be collected through questionnaires and interviews with these stakeholders.

Objective of this study

1.To identify and rank the primary causes of road construction project delays across stakeholders.

2. To identify a possible way to avoid the delay in the road construction projects.

3. To provide recommendations for mitigating or controlling delays in road construction projects.

Literature review

A literature review is crucial for understanding how different countries handle road construction delays. Numerous studies have been carried out in African countries such as Nigeria, Ethiopia, Uganda, Tanzania, and Kenya. However, no research has focused on road construction delays in Somalia, despite the country facing greater challenges due to its long civil war and weak institutions.

In Chana, Aforla, Wood, and Amoah (2016) found that delays in payment certificates, equipment breakdowns, and material shortages were the main problems. These issues are also common in Somalia, but the difference is that Somalia lacks a strong financial system, which makes delays in certificate payments more frequent and difficult to resolve because the process involves multiple organizations.
Kullaya, Alemu, and Yeom (2022) studied Tanzania and identified six major causes, such as lack of funding, delayed payments, and political interference. These issues also appear in Somalia, but political interference is worse there because different ministries and donor agencies control the project simultaneously.

Nigeria, Toriao-cooker (20222) reported that financial difficulties, government regulation, and bad weather were key causes. While Ethiopia and Nigeria have similar institutional capacities to manage these challenges, Somalia is almost entirely dependent on donors such as the World Bank, the African Development Bank (AFDB), and the European Union (EU). This dependency makes Somalia unique, as construction projects are managed by external agencies rather than the national government, leading to weak sustainability.

Therefore, Somalia cases are different from those of other African countries. The combination of insecurity, weak institutional government, and heavy donor dependence makes road construction delays more challenging to control compared to their neighboring countries.

Methodology

The research methodology was structured in six phases. The first phase involved identifying potential causes of delays by reviewing and analyzing previous studies from developing countries. The second phase categorized these causes into four groups: government/owner, consultants, contractors, and external factors. The third phase involved creating the questionnaire using Google Forms. The fourth phase consisted of distributing the questionnaire to selected stakeholders. The fifth phase included reviewing the responses for missing data and cleaning the data. The sixth phase employed the relative importance index (RII) to rank the causes of delays in Somalia.

In this study, a purposive sampling method was used to target respondents directly involved in the road construction project in Somalia. These included officials from the Ministry of Public Works (both federal and state levels), contractor companies, consulting firms, and external partners. Out of 92 distributed questionnaires, 79 were returned, resulting in a response rate of 85.87%. This sample size is considered appropriate in Somalia, given the limited number of qualified professionals, and aligns with other studies. The responses were then analyzed using IBM SPSS v27, and the RII values were calculated to identify the most significant delay factors.

Data Collection

The research aimed to gather opinions from stakeholders, including contractors, consultants, government agencies, and external parties, who are directly or indirectly involved in road construction projects, to identify the primary causes of delays in these projects. The questionnaire was developed based on 55 potential causes of road construction delays and divided into four major groups. For each factor, a response was requested to rate on a fivepoint scale, ranging from 1 to 5. As categorized as flow: 5= Strongly agree, 4= Agree, 3= Neutral, 4= Disagree, 5= Strongly Disagree.

The target respondents are the Ministry of Public Works, Reconstruction, and Housing of the federal government of Somalia, the ministers of public works of federal member states, contractors' companies involved in road construction projects in Somalia, and consultant firms and external parties.

Data Analysis

The Relative Importance Index (RII) is a statistical tool used to rank different factors by their level of importance or impact. It is a non-parametric technique widely used to analyze and rank structural questionnaire responses for data involving ordinal measurement of attitudes. The relative importance index has a value that ranges from 0 to 1. The higher the RII, the greater the impact of the respective delay factor. The formula for finding RII is as follows, $RII = \Sigma W / (A \times N)$

Where:

ΣW = Sum of the weight given to a factor, A = Highest possible ranking (in this case, 5). N = Total number of respondents.

Results and Discussion

Table 1

Distribution of Questionnaire and Response Rate by Stakeholder Group

Respondents	Questionnaire Distributed	Responses Returned	Percentage of Responses (%)
Government/clients	22	20	90.90
Consultant	25	20	80.00
Contractors	25	20	80.00
External parties	20	19	95.00
Total	**92**	**79**	**85.87**

Analysis of The Causes of Delays in The Road Construction Project

A total of 55 causes of delay were identified through various studies in a developing country. The causes of the delay were categorized into four groups: government-related, consultant- related, contractor-related, and external partners.

Analysis of Government-Related Causes of Delay

A total of 15 government-related causes of delay were identified through literature reviews. These causes are being analyzed using the Relative Importance Index (RII).

Table 2

Causes of Delays in Government-Related

Cause of delay	RII	Rank
Weak institutional capacity	0.97	1
Delay in progress payments by the government	0.96	2
Poor contract management	0.92	3

Poor engagement with the local community	0.91	4
Bribes (kickbacks) & personal interest (corruption)	0.84	5
Slowness in decision-making by the government	0.81	6
Delay in reviewing and approving processes	0.81	6
Difficulties in financing projects by the government	0.81	6
Orders changed by the government during construction	0.75	9
Changes in government regulations	0.72	10
Work suspension by the government	0.73	11
Delay municipal approvals	0.70	12
Delay in obtaining permits from the municipality	0.69	13
Delay in delivering the site (handover)	0.67	14

Table 3

The Top Five Government-Related Causes of Delays Based on RII

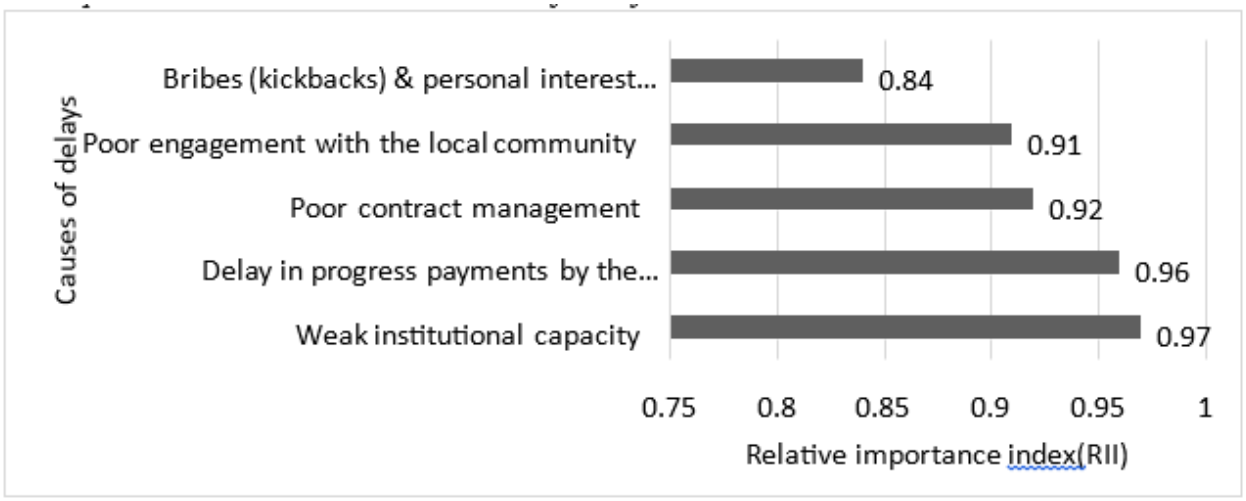


Table 4

Causes Delays in Contractor-Related

Causes of delay	RII	Rank
Low project bid price	0.94	1
Poor communication and coordination by all parties	0.94	1
Insufficient equipment and vehicles for the work	0.81	6
Luck of financing projects	0.86	4
Rework due to errors during construction	0.63	14
Bribes (kickbacks) & personal interest- (corruption)	0.77	10
Poor site management and supervision by the contractor	0.82	5
Ineffective planning and scheduling of projects by the contractor	0.87	3
Less experience of the contractor	0.66	13
Poor qualifications of the contractor’s technical staff	0.71	11
Delay in site mobilization	0.68	12
Delay in material and equipment delivery	0.80	8
Less equipment skills	0.79	9
Lack of high-technology mechanical equipment	0.81	6
Personal conflicts among labors	0.61	15

Table 5

The Top Five Contractor-Related Causes of Delays Based on RII

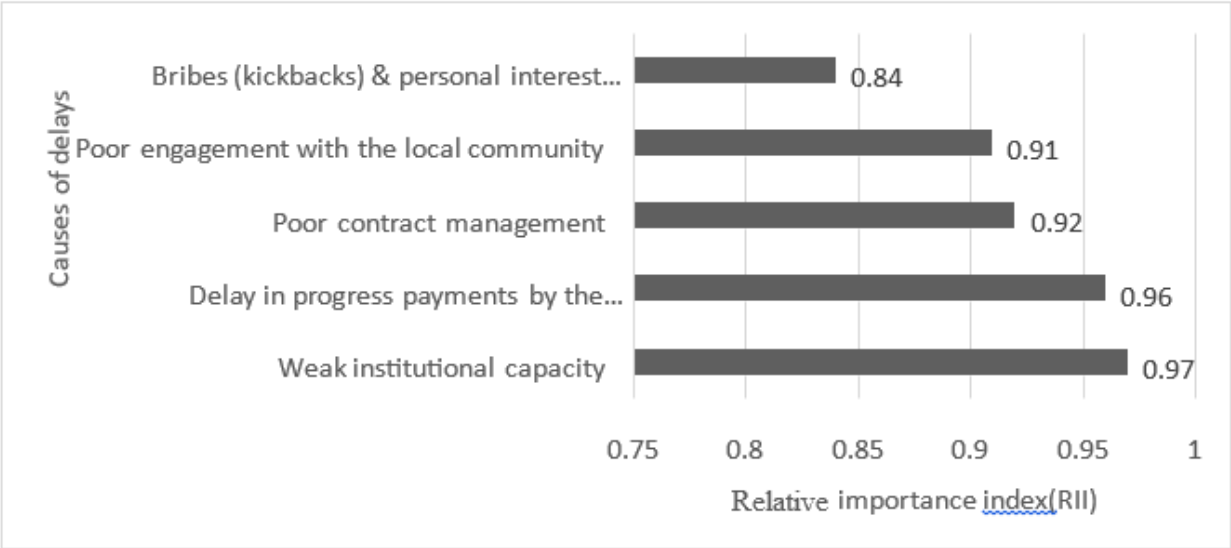


Table 6

Causes of Delays in Consultant-Related

Causes of delay	RII	Rank
Delay in performing inspection and testing by the consultant	0.82	3
Delay in approving major changes in the scope of work by consultants	0.78	6
Delays in preparing design, drawings, and documentation	0.75	8
Late in reviewing and approving design documents by the consultant	0.7	10
Bribes (kickbacks) & personal interest- (corruption)	0.68	11
Inadequate experience/skills of the consultant	0.64	12
Mistakes and inappropriate design in documents	0.77	7
Poor quality control	0.82	3
Unclear and inadequate details in drawings	0.80	5
Complexity of project design	0.73	9
Changing material types and specifications during the construction	0.87	2
Insufficient data collection and survey before the design	0.92	1

Table 7

The Top Five Consultant-Related Causes of Delays Based on RII

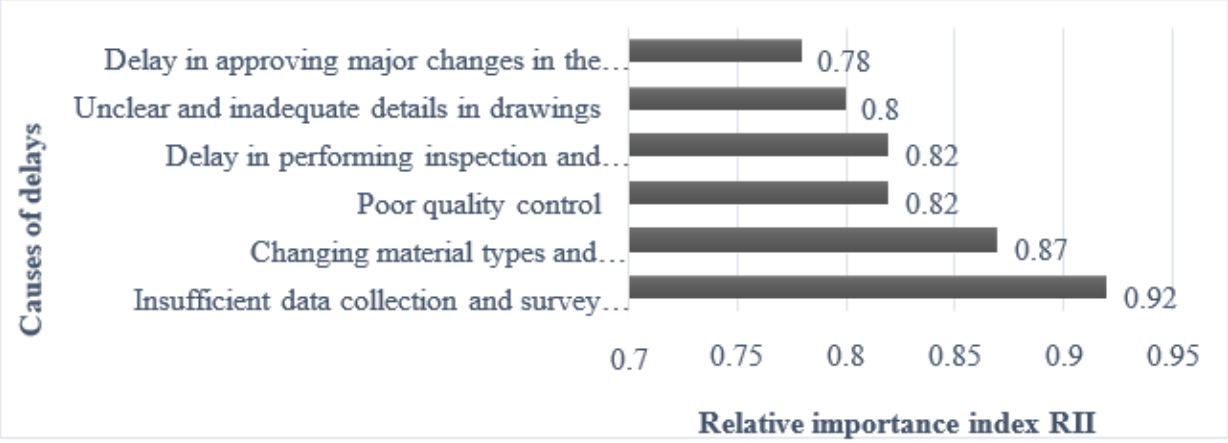


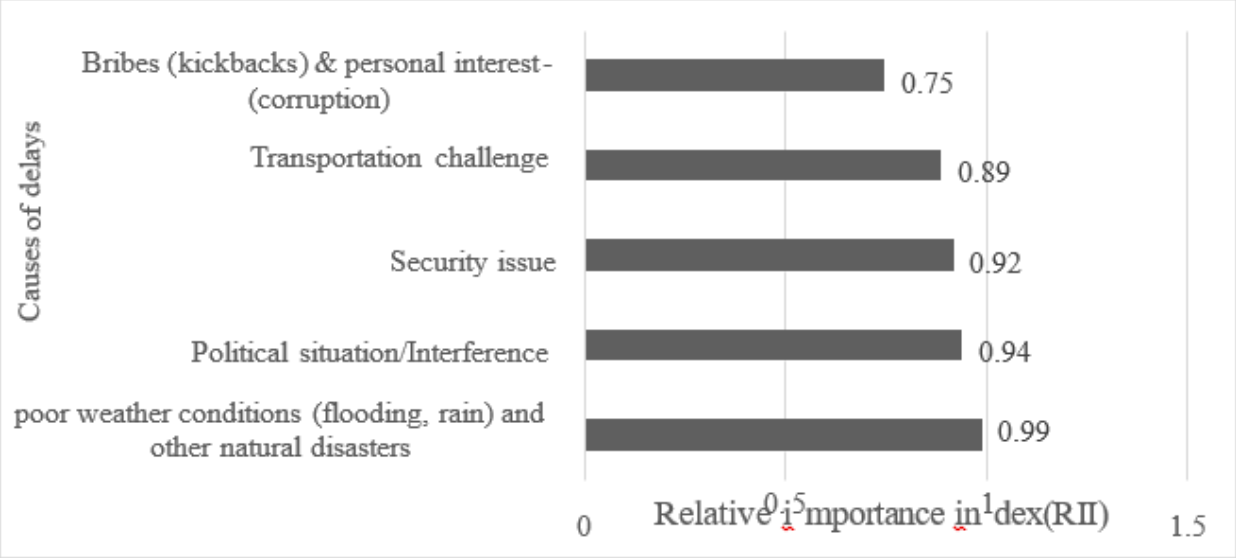
Table 8

Causes Delays in External-Related

Causes of delay	RII	Rank
poor weather conditions (flooding, rain) and other natural disasters	0.99	1
Security issue	0.92	3
Community-related disruptions/Land acquisition	0.60	10
Bribes (kickbacks) & personal interest- (corruption)	0.75	5
High cost of materials due to inflation	0.74	6
Shortage of construction materials	0.71	7
Monopoly market	0.70	8
Political situation/Interference	0.94	2
Transportation challenge	0.89	4
Restriction at the job site	0.63	9

Table 9

The Top Five External-Related Causes of Delays Based on RII



Discussion

The studies identify government-related factors, specifically weak institutional capacity (RII = 0.97) and delayed progress payments (RII = 0.96), as the main causes of road construction delays in Somalia. They emphasize the dual responsibilities of the state and federal ministries, which impede decision-making and accountability. Similar governance challenges have been observed in other developing countries.

For contractors, low bid price and lack of coordination (RII = 0.94) were the most important factors. This highlights a procurement problem where unrealistic bids cause cost overruns and poor project outcomes. Evidence from Uganda and Tanzania indicates that strengthening prequalification and financial capability screening is necessary to enhance contractor performance.

Consultant delays were mainly due to poor data collection before design (RII = 0.92) and weak quality control. This shows that errors during the design phase significantly impact project duration. Similar issues in Nigeria and Ghana highlight the need to train consultants and maintain design standards.

External factors, such as weather conditions (RII = 0.99) and political instability (RII = 0.94), significantly influence Somali road construction projects. While maintenance systems reduce weather impact in Ethiopia, flooding remains especially damaging in Somalia due to the lack of climate-resilient design. Political interference, along with security issues, delays contractor mobilization on time.

Overall, the results show that Somali road construction project delays are caused not only by technical issues but also by governance, procurement, and external risks. These problems will be addressed through reforms in institutions, improved capacity for contractors and consultants, and a financing climate that promotes resilient infrastructure.

Conclusion

The table below 10 shows the top twenty significant causes of road construction projects in Somlai, based on a comprehensive survey conducted among the key stakeholders of road construction projects in Somalia, such as road contractors, consulting firms, government

institutions related to the federal government and federal member states of Somalia, and external partners. This causes the ware to be identified using the relative importance index RII. One of our aims in this research is to identify and avoid the causes of delays in road construction. Delays can be minimized only when their causes are identified, as knowing the causes would help prevent them.

Top Twenty Causes of Road Construction Projects in Somlai

Cause of Delay	RII	Rank
poor weather conditions (flooding, rain) and other natural disasters	0.99	1
Weak institutional capacity	0.97	2
Delay in progress payments by the owner/government	0.96	3
Poor communication and coordination by all parties	0.94	4
Political situation/Interference	0.94	5
Low project bid price	0.94	6
Insufficient data collection and survey before the design	0.92	7
Security issue	0.92	8
Poor contract management	0.92	9
Poor engagement with the local community	0.92	10
Transportation challenge	0.89	11
Changing material types and specifications during the construction	0.87	12
Ineffective planning and scheduling of projects by the contractor	0.87	13
Luck of financing projects	0.86	14
Bribes (kickbacks) & personal interest (corruption)	0.84	15
Delay in performing inspection and testing by the consultant	0.82	16
Poor site management and supervision by the contractor, and Poor-quality control	0.82	17
Lack of high-technology mechanical equipment, and fewer equipment and vehicles for the work	0.81	18
Difficulties in financing projects by the government	0.81	19
Delay in material and equipment delivery	0.8	20

Recommendations

Based on findings and conclusions, several strategies are proposed for reducing road construction delay in Somalia.

1. Government-Related Recommendations

- Enhance institutional capacity through regular training for ministry officials, the implementation of digital project monitoring systems, and the establishment of a centralized project management unit to prevent overlapping activities.

- Insist on timely progress payments by implementing automatic payment monitoring devices tied to milestones and establishing performance-based financing agreements.

- Address political interference by forming an independent monitoring committee composed of donor representatives to enhance accountability.

2. Contractor-Related Schedules

- Prevent unrealistically low bids by replacing the lowest-cost award system with a Quality and Cost-Based Selection (QCBS) system that considers technical ability and financial health.

- Enhance planning and scheduling by requiring contractors to use up-to-date project management software such as MS Project or Primavera.

- Enhance site management by requiring training in supervision and performance measurement.

3. Consultant-Related Recommendations

- Improve design quality by requiring feasibility studies with GIS, soil tests, and recent surveys before issuing tenders.

- Strengthen quality control and supervision by requiring consultants to adopt international best practices and subjecting them to sanctions for repeated design errors.

- Finalize designs and specifications before construction to avoid delays caused by scope changes during mobilization.

4. External-Related Recommendations

- Minimize weather-related disruptions by aligning the project schedule with Somalia's rainy and dry seasons and incorporating climate-resilient road designs such as elevated roadbeds and enhanced drainage systems.

- Improve security coordination by creating joint project security guidelines among contractors, local authorities, and community leaders.

- Boost community engagement by engaging local leaders in project planning and implementing awareness programs to reduce land conflicts and disruptions.

This study used the Relative Importance Index (RII) to identify and rank delays in road construction in Somalia. Although the RII method is widely used and effective for prioritization, it does not examine clusters or correlations among underlying variables. Future research could apply more advanced statistical methods, such as factor analysis or regression analysis, to group similar causes (e.g., financial, institutional, external) and assess the strength of their effects. This would enhance the robustness of the findings and improve their generalizability.

Finally, delays in Somalia's road construction projects require follow-up through institutional reform, improved procurement practices, and capacity building for contractors and consultants. Additionally, measures to address external risks like flooding and insecurity are necessary. If implemented, these actions would improve not only the timely completion of road projects but also the overall governance and resilience of Somalia's infrastructure sector.

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