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**MANAGEMENT PERSPECTIVE
IN MUSEUM LITERATURE WITH
THE EVOLUTION OF HIGH-TECH
APPLICATIONS**

ABSTRACT

The purpose of this paper is to investigate the adoption of information technology in museums and to identify the latest high-tech applications used in museums from the perspective of management. A systematic review of 250 English articles published in SCOPUS, classified into Business, Management, and Accounting, was conducted. The results showed that the number of publications on this topic steadily increased during the study period. The maximum number of publications occurred in 2023 and reached 43 documents. Authors from Europe, North America, and Oceania have contributed more to the investigation of the roles of technologies in museums. The results provide evidence of the significant evolution of high-tech applications in museums that have been investigated recently. Thanks to the Internet, social media, websites, mobile applications, big data, blockchain, etc., communication between museums and not only their visitors but also other stakeholders has improved effectively. In addition, the latest innovations, such as augmented reality, virtual reality, mixed reality, artificial intelligence, and eye-tracking technology, have provided visitors with a better experience in museums.

KEYWORDS: *Museums, Literature Review, High-Tech Application, Management Perspective*

INTRODUCTION

When visiting museums in this digital era, visitors are offered more impressive experiences than ever before. Due to advanced innovation technologies, the public can communicate with museums, enjoy their exhibitions, and obtain all the useful information regarding these cultural institutions with a single click. Consumers certainly take advantage of easy and quick access to information to proactively decide which museum to visit. However, from a management perspective, museums face the challenge of keeping pace with fast-changing high-tech trends and maintaining their attractiveness to their customers.

A significant number of authors considered the relationship between museums and social media (Sundjaja et al., 2017; Vassiliadis & Belenioti, 2017); technology and digital innovations (Hijazi & Baharin, 2022; Taormina & Baraldi, 2022; Tham et al., 2023), and the use of XR Technologies (Komianos, 2022), Augmented Reality (May et al., 2020), Virtual Reality (Yang et al., 2020), Mixed Reality (Okaro & Vlachopoulos, 2020). However, the overall review of museums is limited.

There have been several studies carried out, a systematic review published recently investigating the influence of one specific high-tech application in museums (see Appendix 1). For example, social media is valuable for museum experience (Vassiliadis & Belenioti, 2017) and communication (Douros et al., 2023). Furthermore, the role of technology in supporting real-life usability was investigated (Garcia Carrizosa et al., 2020). Furthermore, there is a four-stage model of the evolution of technology in museum visitor experiences (Lu et al., 2023).

This research aims to investigate the adoption of information technology in museums and to identify the latest high-tech applications used in museums from the perspective of management. The results illustrated the main trends of scientific attention among English-speaking communities. The next section will present the method adopted in this study. Then, the results section will show the analysis of references based on their year of publication, authors' keywords, and correspondence authors. Finally, the conclusions will summarize the key findings, limitations of this review, and possible future research directions.

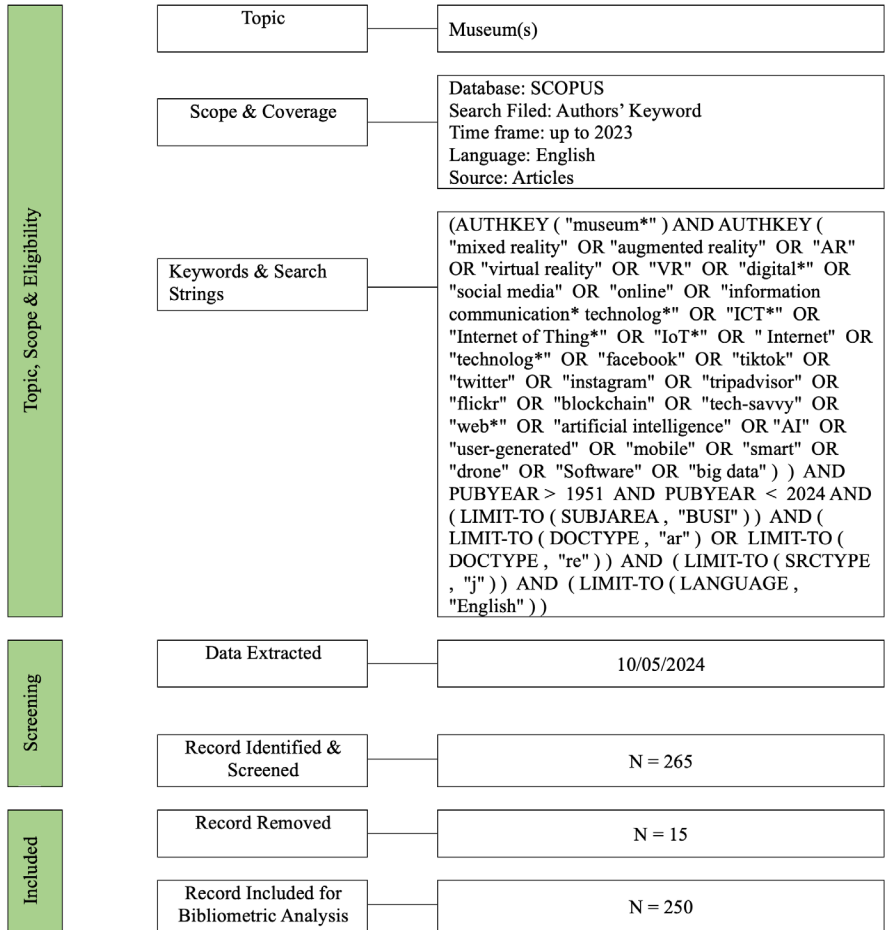
RESEARCH METHODS

A systematic literature review was conducted based on SCOPUS, one of the largest peer-reviewed scientific literature with large databases of scientific journals. The term used in the search engine was 'museum *' and specific terms reflect high-tech applications, which were applied to the keywords defined by its authors (see Figure 1). The category of Business, Management and Accounting (in this article simplified as a management perspective); English peer-reviewed articles were published before 2024. Data collection was conducted in May 2024, and a total of 265 articles were initially featured.

An initial scan found that 4 duplications and 1 article without an author/authors were removed from the list of publications. Subsequently, after reading the titles and abstracts of 260 articles, 6 publications were found not to be related to the research objectives, and the full text of 4 articles was not found. Therefore, the final sample consisted of 250 articles for analysis. The search strategy is presented in Figure 1.

In the first 10 years, 35 articles were published, representing 14% of the total publications to date, there are 10 publications found in 2012. From 2013 to 2018, the number of publications increased slightly between 8 and 13. Figure 2 shows the evolution of scientific production in museums during the period 2003-2023.

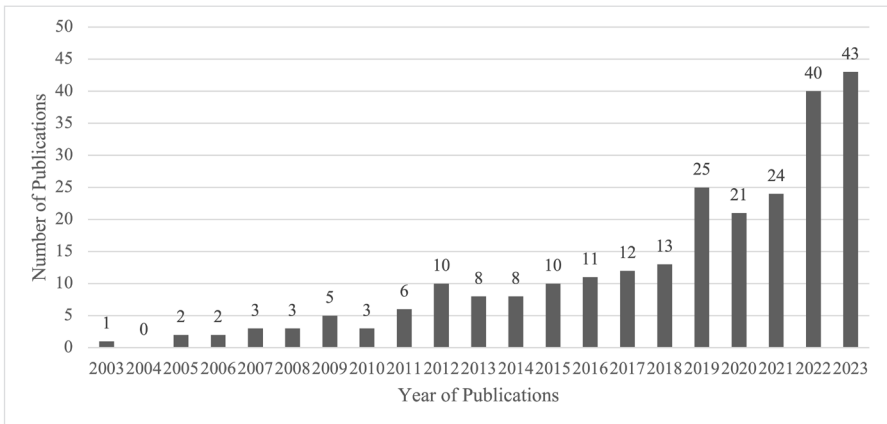
Figure 1. Diagram of the search strategy. Adopted from Zakaria et al. (2020)



RESEARCH RESULTS

Figure 2 shows the increase over the years in the number of museum publications with the adoption of high-tech innovation up to the present. There is progress in the annual volume of publications throughout the period, even though a slight drop in 2020 and 2021 due to the impact of the COVID-19 pandemic. In the last 2 years, the number of publications has almost doubled compared to the 2 previous years.

Figure 2. *Evolution in the number of articles on museums*



The journal with the greatest impact on this study is Museum Management and Curatorship in terms of the number of publications. Table 1 shows the journals ordered by the number of documents published. It can be said that the top eight journals contain 121 articles (48.4%) in total, and only Museum Management and Curatorship published 80 articles (32%).

Table 1. *The top eight journals published articles on museums and high-tech applications*

Name of Journal	Number of publications	Percentage
Museum Management and Curatorship	80	32.00%
Current Issues in Tourism	9	3.60%
Journal of Heritage Tourism	6	2.40%
International Journal of Arts Management	6	2.40%
Information and Management	5	2.00%
International Journal of Heritage Studies	5	2.00%
Tourism Management	5	2.00%
Tourism Management Perspectives	5	2.00%

Figure 3 presents the number of publications in the top 8 journals that contributed the most to museums per year. It is clear that there have been many more journals interested in this topic. Museum Management and Curatorship is the journal that contributed the highest number of publications between 2005 and 2023, and the highest annual production. In 2023, this journal published 14 articles, the highest number of publications during the study period. In addition, although Current Issues in Tourism just took part in the topic recently (later than other publishers) in 2020, there have been published 9 articles in 3 years with the most remarkable contributions in 2022 (6 publications).

Figure 3. *The Annual Production of Journals*

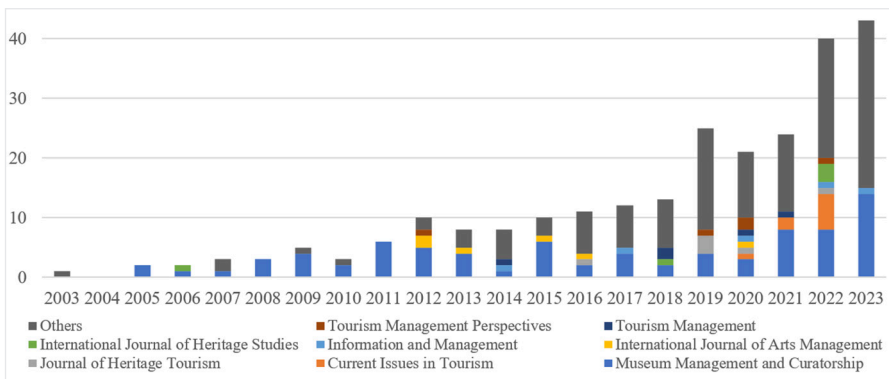


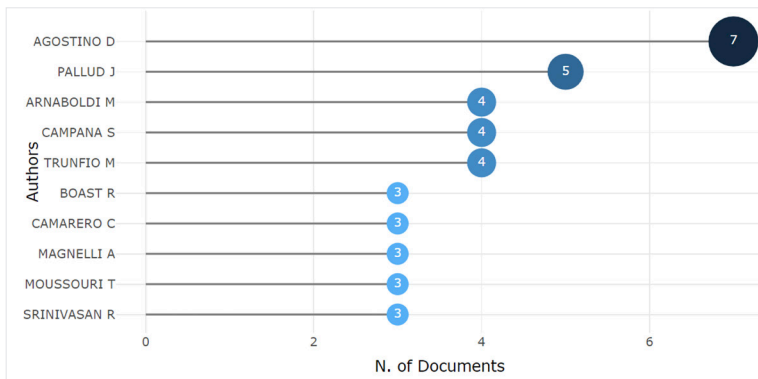
Table 3 shows the ranking of articles based on the number of citations received within the database and determines the popularity of an article in the domain. He et al. (2018) received the highest ranking value in citation (250), followed by Lee et al. (2020) and Choi and Kim (2017) have citation values of 196 and 176, respectively. The key reason was that these authors discussed and emphasised the roles of immersion in a virtual reality environment that contribute to two major issues facing today's museums, authenticity and new museology.

Table 3. *Top 10 articles in terms of citations received included in the SCOPUS database (ordered by total citations)*

Authors	Title	Year	Source Title	Cited by
He Z.; Wu L.; Li X.R.	When art meets tech: The role of augmented reality in enhancing museum experiences and purchase intentions	2018	Tourism Management	250
Lee H.; Jung T.H.; tom Dieck M.C.; Chung N.	Experiencing immersive virtual reality in museums	2020	Information and Management	196
Choi H.-S.; Kim S.-H.	A content service deployment plan for metaverse museum exhibitions—Centering on the combination of beacons and HMDs	2017	International Journal of Information Management	176
Agostino D.; Arnaboldi M.; Lampis A.	Italian state museums during the COVID-19 crisis: from onsite closure to online openness	2020	Museum Management and Curatorship	137
Pallud J.; Straub D.W.	Effective website design for experience-influenced environments: The case of high culture museums	2014	Information and Management	120
Agostino D.; Arnaboldi M.; Lema M.D.	New development: COVID-19 as an accelerator of digital transformation in public service delivery	2020	Public Money and Management	119
Marty P.F.	Museum websites and museum visitors: Before and after the museum visit	2007	Museum Management and Curatorship	113
Fletcher A.; Lee M.J.	Current social media uses and evaluations in American museums	2012	Museum Management and Curatorship	112
Serravalle F.; Ferraris A.; Vrontis D.; Thrassou A.; Christofi M.	Augmented reality in the tourism industry: A multi-stakeholder analysis of museums	2019	Tourism Management Perspectives	112
Trunfio M.; Lucia M.D.; Campana S.; Magnelli A.	Innovating the cultural heritage museum service model through virtual reality and augmented reality: the effects on the overall visitor experience and satisfaction	2022	Journal of Heritage Tourism	106
Su Y.; Teng W.	Contemplating museums' service failure: Extracting the service quality dimensions of museums from negative on-line reviews	2018	Tourism Management	103

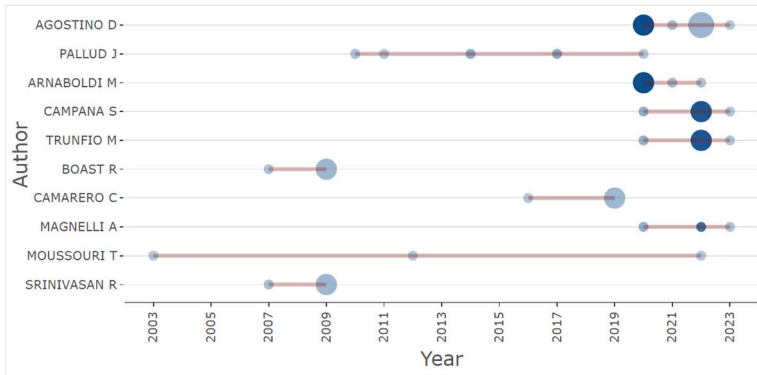
Figure 4 provides information on the orders for the publications of the most recognised authors. Agostino D. has published seven articles on the research topic in four years from 2020 to 2023 (see Figure 5). With 5 articles published in 2010 and 2020, Pallud J. is second on the list. In the last 4 years, academic communities have witnessed the significant contribution of Arnaboldi M., Campana S., and Trunfio M. (Agostino & Arnaboldi, 2021; Agostino et al., 2020; Agostino & Costantini, 2022; Marini & Agostino, 2022; Riva & Agostino, 2022) with 4 publications.

Figure 4. *Most relevant authors*



Boast R., Camarero C., Magnelli A., Moussouri T., and Srinivasan R. have published the same number of articles (3 publications). While Boast R. and Srinivasan R. had one paper in 2007 and two articles in 2009 on museums, Moussouri T. published a paper almost every 10 years. Magnelli A. participated in the museums in 2020 and had two other publications in 2022 and 2023. The first articles on the museums of Camarero C. were published in 2016, and then in 2019, he introduced two papers on this topic. It can be seen in Figure 5 that since 2020, there have been a few authors (2% of the papers) who have started to publish in museums regularly. They have published at least one paper annually, so the field is widely diversified in terms of authorship.

Figure 5. Authors' Production Over Time



Italy (45 publications) the United States (42 publications), and the United Kingdom (25 publications) are the most prominent countries in relation to the countries of the corresponding authors (Figure 6). Although the US took second place in the list of the largest number of publications in terms of countries/ regions of the correspondence authors, the researchers from the USA broke the record when published 12 articles in 2023 (see Figure 7).

Figure 6. The number of publications of country / region correspondence authors

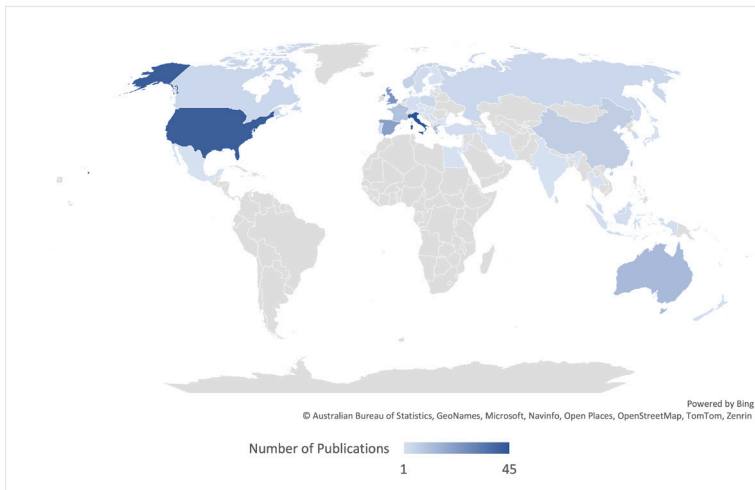
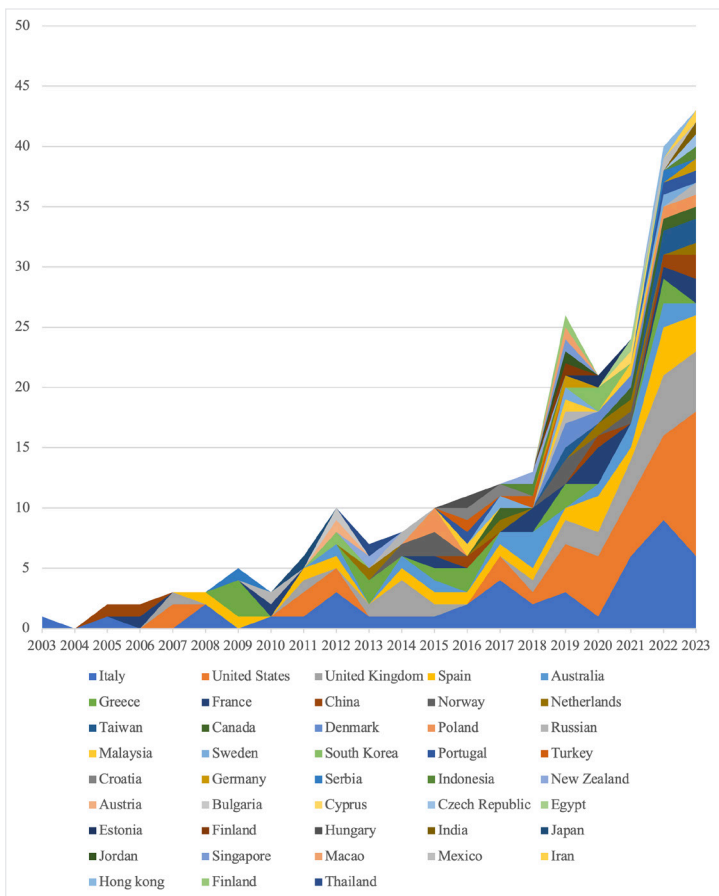


Figure 7 visualises the number of publications per country/ region over the 40-year period. The number of countries/ regions has a positive relationship with the volume of published articles in the topic of museums and technology. Indeed, recently when the number of publications has grown, the number of countries/ regions taken part in this field have increased. In 2019, there were 17 countries/regions of correspondence authors published the articles on technology and museums, however, this was beaten by the new record in 2023 with the participation of 18 countries/ regions.

Figure 7. *Countries’ Production Over the time*

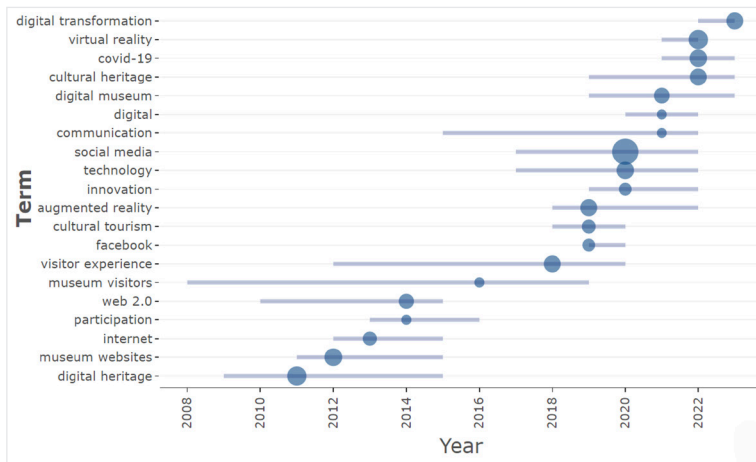


It is clear that Europe, North America, and Oceania have contributed to investigating the relationship between technology and museums. China is the only Asian representative in the top 10.

Figure 8. *Word cloud*



Figure 8 is a visual representation of the frequency in the authors' keywords of the collected articles. Social media (38 times) is the key topic explored. The word cloud shows that social media and several high-tech innovation applications can be listed as augmented reality (11 times), virtual reality (16 times), museum websites (12 times), etc. in museum studies. Thanks to modern technologies (12 times), especially the impact of Covid-19 (12 times), museums have been in the process of digital transformation (11 times), which improves the experience of visitors (11 times). Many different museums' stakeholders can also can participate in, communicate, and participate in the digital heritage (15 times). Museums are one of the cultural institutions, so, undoubtedly, cultural heritage (11 times) is one of the main research topics. This leads to an extension of the contribution to the development of tourism, particularly cultural tourism. Moreover, it can be said that museums have a social responsibility when they help educate their visitors through various types of exhibitions and collections.

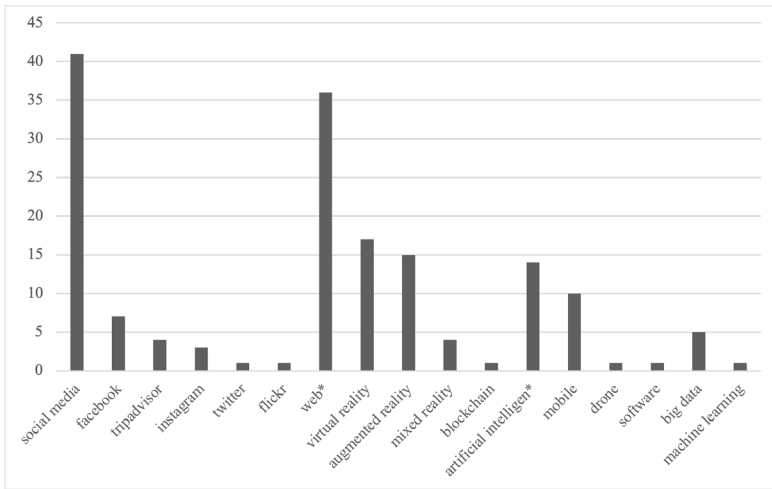
Figure 9. Trends in museums from the management perspective

Since 2010, a variety of research topics have investigated museums (see Figure 9). It can be seen that researchers have paid attention to topics of innovation, social networks, and virtual reality in museums recently. After the global outbreak of the COVID-19 pandemic in 2020, a change in behaviour can be witnessed in all aspects of life, and museums are not immune to this trend. Several authors have investigated the influences of COVID-19 on this specific type of cultural institution.

Figure 10 presents several different high-tech applications in the museum studied from the perspective of management. The most significant number of articles investigate the role of social media in general in museums, and some other publications provide the influence of specific online social media such as Instagram (Bosello & van den Haak, 2022; O'Hagan, 2021; Suess & Barton, 2022), Facebook (Blasco-Lopez et al., 2019; Mas et al., 2021; Pluszyńska & Laberschek, 2022; Vlachvei & Kyparissis, 2017; Waller & Waller, 2019), and Trip Advisor (Carter, 2015) in this field. These platforms have been the tools for promotion (Mas et al., 2021), understanding the visitor (Pluszyńska & Laberschek, 2022) and their experience at museums through their online reviews (Waller & Waller, 2019), and their visit intentions (Blasco-Lopez et al., 2019). Communication through museum websites is also a popular research topic. Moreover, in the last 5 years, the academic community of museums

has paid more attention to Augmented Reality, Virtual Reality, and Mixed Reality. In addition, it can be seen that the latest high-tech innovations such as blockchain, Artificial Intelligence, Big Data, Eye-tracking technology, drones, and live, etc. are continuously being adopted in museums to improve the service quality, the experience of visitors, and to attract more people to the museums.

Figure 10. *Several publications defined high-tech applications within the keywords in museum research*

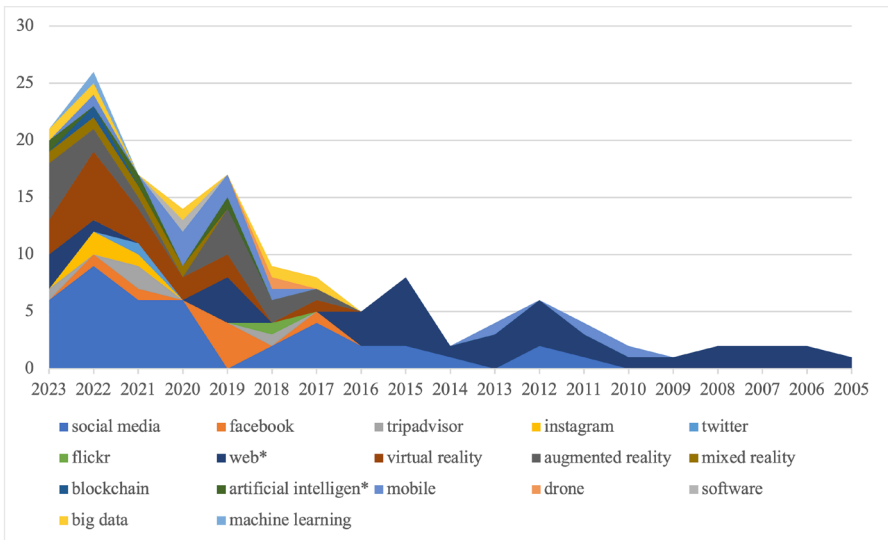


Augmented reality enhances the museum experience (Cranmer, 2019; Moorhouse et al., 2019) and purchase intention (He et al., 2018), while virtual reality also influences immersive experiences, overall museum VR tour experience, and intention to visit a museum (Lee et al., 2020).

Figure 11 shows that when technology is more developed, the number of publications in high-tech adoptions in museums increases. Furthermore, a variety of innovative applications used that have been the objectives of museum studies have been used. It can be seen that websites are the first information technology adopted in museums since 2005. Mobile is the next application used in museums first in 2010. One year later in 2011, the first publication of social media in museum study was introduced. In addition, in 2017, big data, virtual reality, and augmented reality were investigated in a museum

context. The latest technology, artificial intelligence has been adopted in museums and has started to research in 2019. For example, forecasting algorithms have been adopted to predict tourism demand at the micro level (Volchek et al., 2019). The collected data on the number of visits to museums and the application of computer vision (Villaespesa & Murphy, 2021) have been vital for the museum’s management. On 30 November 2022, after the introduction of OpenAI on ChatGPT, this hit brought changes to the tech world. This chat box and virtual assistant was adopted in developing the museum guide system to improve the museum experience (Trichopoulos et al., 2023).

Figure 11. *The research trend of high-tech applications in museums over time*



CONCLUSIONS

The research investigated trends and patterns in museums in one of the SCOPUS subject areas, Business, Management and Accounting, from 2003 to 2023 using a systematic analysis research technique. In this paper, variant charts including the year of publication, authors, journals, keywords, and countries of the correspondence authors were examined to provide more information. The results indicated that research on the adoption of high tech in museums steadily increased during the study period. The trend of publications is still growing. Furthermore, the main authors are from European countries.

While other reviews on museums classified in Business, Management, and Accounting investigate the specific influence of social media (Vassiliadis & Belenioti, 2017), digital innovations (Tham et al., 2023), audience development (Ayala et al., 2020), marketing, and visitor services (Kawashima, 1998), this study generally provides the evolution of high-tech applications used in museums.

It is undoubted that museums have taken advantage of websites to present themselves on the Internet, and closer the distance with the audience and stakeholders. Since 2011, thanks to the popularity of social media, museums have communicated effectively in two-way with their visitors. And recently, due to the impact of the COVID-19 pandemic, museums have increasingly connected with their visitors through social media, and digital museums are considered a contemporary form. It is concluded that museums have been updated in adopting the latest innovations to enhance their visitor experience; however, the number of research is still limited.

There are several limitations of this article that future research can improve. Firstly, the search strings used in this study were selected based on the own knowledge of the authors on high-tech applications. In addition, the evolution of cross-discipline studies has been witnessed recently; there are several research categorised in Computer Science or other fields that also investigate the high-tech applications in museums. Therefore, any future study will be able to extend the research by including many different categories.

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Appendix 1. Summary of review papers on museums categorized into Business, Management, and Accounting subject areas on SCOPUS

Authors (Year of Publication)	Title of articles	Number of analyzed units	Research Findings
Vassiliadis C.A.; Belenioti Z.-C. (2017) in <i>Tourismos</i>	Museums & cultural heritage via social media: An integrated literature review	54	the opportunities of social media to museum experience and communication; social media enhancement to museums' learning process; patterns of social media use in museums; problems and barriers attendant to social media integration in museums.
Garcia Carrizosa H.; Sheehy K.; Rix J.; Seale J.; Hayhoe S. (2020) in <i>Journal of Enabling Technologies</i>	Designing technologies for museums: accessibility and participation issues	8	the concept of accessibility has nuanced meanings, underpinned by social values; the attractiveness of a technology is important in supporting real-life usability; and the conceptualization of participation should extend beyond the end users.
Tham A.; Liu Y.; Loo P.T. (2023) in <i>Tourism Review</i>	Transforming museums with technology and digital innovations: a scoping review of research literature	199 (2010–2021)	elucidate the status quo and future directions of digital innovation in museum space
Douros P.; Papageorgiou K.; Milioris K.; Panagiotakopoulou K.; Kaldis P. (2023) in <i>Transnational Marketing Journal</i>	Digital transformation using marketing strategies in cultural organizations and diffusion of knowledge through technology, a systematic literature review	81	<ul style="list-style-type: none"> - Emphasize the transformative potential of digitalization in the tourism industry to enhance visitors' experience. - Utilizing digitally created content on social media platforms is a valuable marketing strategy for engaging and interacting with current and potential visitors.
Lu S.E.; Moyle B.; Reid S.; Yang E.; Liu B. (2023) in <i>Information Technology and Tourism</i>	Technology and museum visitor experiences: a <u>four stage</u> model of evolution	122	<ul style="list-style-type: none"> - A clear shift of the concepts studied from learning and interaction with technology, intention and behaviour emerged in discourse, to satisfaction, enjoyment, and virtual presence. - Museum visitor experiences have shifted from basic computer displays to innovative smart technology. - A four-stage model of Evolution: ICT Incubation; Smart Technology Adoption; ICT Transformation; and Futuristic Innovation.