A Review on the Issues and Challenges of Heritage Preservation in the Industry Revolution 4.0

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Abstract
The preservation of cultural heritage has always been an important concern for societies around the world. With the advent of Industry 4.0, however, it has become increasingly difficult to maintain and protect historical and cultural artifacts. Industry 4.0, characterized by advanced technologies such as artificial intelligence, the Internet of Things, and automation, has revolutionized the way we live, work, and communicate. These advancements have also brought new challenges to heritage preservation, which is important for maintaining cultural identity, promoting tourism and economic development, supporting education, protecting the environment, and fostering community pride. Challenges to heritage preservation in the Industry 4.0 era include the use of technology in preservation, the impact of Industry 4.0 on the physical environment, the rise of digital culture, the cost of preservation efforts, and the lack of awareness and education. Addressing these challenges requires a collaborative effort from governments, institutions, and communities worldwide to ensure that cultural heritage is preserved for future generations. Preserving cultural heritage in the Industry 4.0 era requires a multifaceted approach that leverages technology, promotes sustainability, fosters digital culture, and promotes collaboration and partnerships. By working together and raising awareness, we can ensure that cultural heritage is preserved for future generations.
Keywords: Heritage, Preservation, I.R. 4.0

Introduction
Heritage preservation has always been a significant concern for societies all around the world. With the rise of Industry 4.0, it has become increasingly challenging to maintain and protect historical and cultural artifacts (Shaharuddin et. al., 2021). The Fourth Industrial Revolution is

characterized by the integration of advanced technologies like artificial intelligence, the Internet of Things (IoT), and automation, among others (Lat et. al., 2021). While these advancements have revolutionized the way we live, work and communicate, they have also brought about new challenges to heritage preservation.

Heritage preservation, also known as cultural heritage preservation, is the act of protecting and conserving cultural, historical, and natural resources that are of importance to a society or community. This includes the preservation of buildings, monuments, artifacts, landscapes, and other elements of a community's cultural and historical heritage (Yotsumoto and Vafaderi, 2021; Ahmad, 2006).

Heritage preservation is important for a number of reasons. First and foremost, it helps to maintain a connection to the past, allowing people to learn about and appreciate the history of their community. It also helps to promote tourism and economic development, as heritage sites can be a major draw for visitors (Feigenblatt, 2020).

Preservation can take many forms, including restoration, rehabilitation, and adaptive reuse. It may involve physical interventions such as repairs, maintenance, or reconstruction, as well as non-physical measures such as education and awareness-raising.

Effective heritage preservation requires a collaborative effort from all members of a community, including government officials, heritage professionals, and members of the public. It also involves balancing the need for preservation with the practical considerations of everyday life, such as development, economic growth, and changing social values (Tacon and Baker, 2019).

The Importance of Heritage Preservation

Heritage preservation is important for maintaining our cultural identity, promoting tourism and economic development, supporting education, protecting the environment, and fostering community pride. Other than that, heritage preservation is important for a variety of reasons, including (Nilson and Thorell, 2018; Onyima, 2016; Naboodah, 2011; Spenneman and Graham, 2007)

i. Cultural identity: Our heritage is an integral part of our cultural identity. It reflects our history, traditions, and values. Preserving heritage sites and objects helps us connect to our past and understand our roots.

ii. Tourism: Heritage sites and landmarks often attract tourists, generating revenue and providing jobs. This can help boost local economies and support cultural tourism.

iii. Education: Heritage sites and objects can be valuable teaching tools for schools, universities, and museums. They can help educate people about their cultural heritage, history, and traditions.

iv. Environmental conservation: Many heritage sites are also natural landmarks or located in environmentally significant areas. Preserving these sites can help protect biodiversity and natural resources.

v. Community pride: Preserving heritage sites and objects can help foster a sense of community pride and ownership. It can also help build stronger communities by bringing people together around shared cultural values and traditions.

Heritage Preservation in Malaysia

Heritage preservation is an important issue in Malaysia, a country with a rich cultural and historical heritage. Malaysia has a diverse population made up of Malays, Chinese, Indians,

and other ethnic groups, each with their own unique cultural traditions and practices. The country is also home to numerous historic sites, including temples, mosques, palaces, colonial buildings, and archaeological sites.

To preserve and promote Malaysia's cultural heritage, the government has taken a number of steps, including the establishment of the National Heritage Department, which is responsible for identifying and protecting heritage sites across the country (Suaib et. al., 2020). The department works closely with local communities, heritage experts, and other stakeholders to develop strategies for the preservation and promotion of Malaysia's cultural heritage (Mustafa et. al., 2013).

In addition, the government has designated numerous sites as national heritage sites, including the historic city of Malacca, the Lenggong Valley Archaeological Site, and the Mulu National Park, among others (Mahdzar et. al., 2015; Mei, 2015; Harun and Ismail, 2011). These sites are protected by law, and efforts are made to ensure that they are preserved for future generations.

The private sector has also played an important role in heritage preservation in Malaysia, with many companies and organizations sponsoring restoration projects and cultural events. For example, the Malaysian Heritage Trust, a non-governmental organization, has worked to promote the preservation of Malaysia's heritage through education, advocacy, and community engagement (Lim et. al., 2021; Rahma, 2021).

Despite these efforts, however, there are still challenges to heritage preservation in Malaysia. Rapid urbanization and development have led to the destruction of many historic buildings and sites, and there is often a lack of resources for the proper maintenance and upkeep of heritage sites (Ismail et al., 2014). In addition, there are sometimes conflicts between the government, local communities, and developers over the use and management of heritage sites (Harun, 2011; Said et al., 2013).

Overall, while there are challenges to heritage preservation in Malaysia, there is also a strong commitment to preserving the country's cultural heritage and promoting it to both domestic and international audiences.

The Challenges of Heritage Preservation in the Industry Revolution 4.0
The Industry 4.0 era has brought about numerous challenges to heritage preservation. These include the use of technology in preservation, the impact of Industry 4.0 on the physical environment, the rise of digital culture, the cost of preservation efforts, and the lack of awareness and education (Petracek et. al., 2023; Mu'az et al., 2021; Alaloul et. al., 2018). Addressing these challenges will require a collaborative effort from governments, institutions, and communities worldwide to ensure that cultural heritage is preserved for future generations.

The Use of Technology
One of the most significant challenges facing heritage preservation in the Industry 4.0 era is the use of technology in the preservation process. While technology has undoubtedly helped in preserving and restoring cultural artifacts, it has also led to the loss of traditional methods of preservation. For instance, the use of 3D scanning technology can help in creating digital copies of artifacts, but it cannot replace the traditional methods of preservation. This has resulted in a loss of expertise in traditional preservation methods, which is a significant concern (Aburamadan et. al., 2021).

The use of technology can present challenges in heritage preservation for several reasons. Firstly, technology can be rapidly evolving, and it can be difficult to ensure that digital data and technology are maintained and preserved over time. This can result in issues with data loss or format obsolescence, making it difficult to access or interpret digital heritage resources in the future (Shan et. al., 2022).

Secondly, there can be ethical and legal considerations surrounding the use of technology in heritage preservation. For example, the use of 3D scanning and printing technologies to create replicas of cultural objects and sites can raise questions about ownership, authenticity, and the potential for cultural appropriation or misrepresentation (Bozorgi and Lischer, 2020; Champion and Rahaman, 2019).

Thirdly, there may be technical limitations or barriers to the use of technology in heritage preservation, particularly in developing countries or areas with limited infrastructure. This can result in unequal access to digital heritage resources and difficulties in sharing and collaborating on preservation efforts (Ahmad and Sharma, 2020).

Overall, while technology has the potential to aid in the preservation and sharing of heritage resources, it is important to carefully consider the challenges and limitations associated with its use in order to ensure that these resources are effectively preserved and made accessible to future generations.

Impact on Physical Environment
Another challenge is the impact of Industry 4.0 on the physical environment. The use of advanced technologies has led to an increase in industrialization and urbanization, resulting in the destruction of cultural heritage sites (Mason and Page, 2004). For example, construction projects that require large amounts of land have led to the destruction of historical sites, including ancient buildings and monuments. Furthermore, the increase in air pollution, caused by industrialization, can also damage artifacts, leading to their decay and eventual loss (Indrie et. al., 2019; Lidelow et. al., 2019).

Industry 4.0, which refers to the fourth industrial revolution characterized by the integration of advanced technologies such as artificial intelligence, the internet of things, and robotics, has the potential to significantly impact the physical environment. One of the challenges that arise from this impact is the preservation of cultural heritage.

Cultural heritage includes tangible assets such as historic buildings, monuments, and archaeological sites, as well as intangible assets such as traditional knowledge and cultural practices. Industry 4.0 technologies can potentially impact cultural heritage in several ways. For instance, the use of heavy machinery and construction equipment during the development and deployment of Industry 4.0 technologies can result in damage to historical buildings and archaeological sites (Sklokina and Kulikov, 2021; Umar and Said, 2019).

Moreover, the implementation of Industry 4.0 technologies can result in the displacement of traditional communities and the loss of cultural practices and knowledge. This can lead to the erosion of cultural diversity and the disappearance of cultural heritage (Ruhanen and Whitford, 2021).

Therefore, the preservation of cultural heritage in the face of the impact of Industry 4.0 on the physical environment presents a significant challenge. It requires a careful balance between the development and deployment of advanced technologies and the protection and preservation of cultural heritage. This necessitates the adoption of sustainable and culturally sensitive approaches to the development and deployment of Industry 4.0 technologies.

The Rise of Digital Culture
The rise of digital culture is also a significant challenge to heritage preservation. In the Industry 4.0 era, people rely heavily on digital platforms to access information and culture. This has led to a shift in the way people perceive heritage, with many preferring digital experiences to physical ones. This shift has resulted in a lack of interest in preserving physical artifacts, which can lead to their eventual loss (Harrison et. al., 2020).

The rise of digital culture has undoubtedly revolutionized the way we interact, consume, and create content. With the advent of digital technology, we have witnessed the rapid growth of new forms of media, including social media, digital archives, and virtual reality. While these developments have opened up new possibilities for accessing and sharing information, they have also presented significant challenges to heritage preservation.

One of the most significant challenges is the sheer volume of digital content that is being produced every day. With so much content being generated, it can be challenging to identify what is worth preserving and what is not. Additionally, digital content can be easily duplicated and disseminated, making it challenging to track and manage. This presents a significant challenge to heritage preservation, as it can be challenging to determine what digital materials should be preserved for future generations (Nilson and Thorell, 2018).

Moreover, digital materials are often created in formats that can quickly become obsolete. Technology changes rapidly, and the software and hardware required to access digital content can quickly become outdated, making it difficult to preserve digital heritage for future generations. Furthermore, digital content can be easily altered, manipulated, or lost, and there are no guarantees that digital materials will remain intact over time (Rahma, 2021; Harrison et. al., 2020).

Finally, the rise of digital culture has also challenged traditional forms of heritage preservation. Physical artifacts, such as books, documents, and photographs, have historically been preserved through careful conservation efforts. However, digital content is often intangible and ephemeral, making it difficult to preserve in the same way as physical artifacts (Permatasari et. al., 2020).

In conclusion, the rise of digital culture has presented significant challenges to heritage preservation. While digital technology offers new possibilities for accessing and sharing information, it also presents significant obstacles to preserving our cultural heritage for future generations.

Cost
Another challenge is the cost of heritage preservation. The use of advanced technologies in heritage preservation is costly, making it challenging for smaller institutions and communities to afford preservation efforts (Jin et. al., 2019). Additionally, many countries lack the necessary funding to preserve their cultural heritage adequately. This has resulted in a lack of resources to preserve and restore heritage sites, leading to their eventual loss.

The cost of heritage preservation can be a significant challenge in the context of Industry 4.0 (I.R.4.0). While technological advancements have made certain aspects of preservation more efficient, they have also increased the cost of many preservation methods (Rudokas et. al., 2019).

For example, using advanced technologies such as 3D scanning and printing, drones, and other sophisticated equipment can be expensive to purchase and maintain. In addition, the process of digitizing heritage assets, such as historical documents and artifacts, can require specialized expertise, which can be costly to acquire and retain.

Furthermore, the integration of digital preservation techniques into traditional preservation practices can add additional expenses to heritage preservation. For instance, the cost of data storage, software, and hardware required to maintain digital archives can be substantial (Bec et. al., 2021).

Finally, there is a need for ongoing maintenance of preserved heritage sites and artifacts. The cost of maintaining these sites and objects, such as the cost of cleaning, restoring, and repairing, can be significant and ongoing (Denis, 2019; Rahman et al., 2012; Akasah et al., 2011).

In summary, while Industry 4.0 technologies can improve the efficiency of heritage preservation, they can also increase the cost of preservation. Thus, finding ways to balance the benefits of advanced technologies with the cost of heritage preservation is a significant challenge that needs to be addressed.

Lack of Awareness and Education

In the Industry 4.0 era, the lack of awareness and education is a significant challenge to heritage preservation. As technology continues to advance rapidly, it becomes increasingly important to preserve our cultural heritage and historical artifacts. However, many people may not understand the importance of preserving our heritage, or they may not know how to go about doing so.

One way that the lack of awareness and education affects heritage preservation is by leading to the destruction or neglect of historical artifacts (Borri and Corradi, 2019). For example, developers may tear down historic buildings to make way for new construction projects because they don't realize the cultural significance of the buildings. Similarly, artifacts may be discarded or damaged because people don't know how to care for them properly (Mohamad et al., 2015).

Another way that the lack of awareness and education affects heritage preservation is by hindering efforts to digitize and preserve historical artifacts (Ahmad and Sharma, 2020). Digitization can be an excellent way to preserve artifacts, making them more accessible to people around the world. However, digitization requires specialized knowledge and equipment, and many organizations may not have the resources or expertise to carry out the process effectively (Bozorgi and Lischer, 2020).

Finally, the lack of awareness and education can also hinder efforts to promote heritage tourism. Heritage tourism can be an essential source of revenue for many communities, but it requires an understanding of the cultural significance of the local heritage (Permatasari et. al., 2020). Without this understanding, communities may not be able to effectively market their heritage to tourists, leading to missed economic opportunities.

In conclusion, the lack of awareness and education is a significant challenge to heritage preservation in the Industry 4.0 era. To overcome this challenge, it is important to educate people about the importance of preserving our cultural heritage, as well as to provide the necessary resources and expertise to preserve artifacts effectively.

Possible Steps Towards Improvement of Existing Efforts

The challenges posed by Industry 4.0 to heritage preservation require a multifaceted approach that involves various stakeholders. Governments can play a crucial role in establishing policies and regulations that support heritage preservation efforts, such as providing funding or incentives for conservation projects (Mohamad et al., 2015; Akasah et al., 2011). Institutions can use technology to enhance preservation efforts, such as using

digital imaging and 3D modeling to document heritage sites and artifacts. Communities can also play a vital role in preserving heritage by raising awareness and taking part in conservation efforts (Onyima, 2016).

One example of successful heritage preservation in the Industry 4.0 era is the digitization of the Vatican Library's collection of manuscripts and documents (Cashion, 2015). The library used state-of-the-art technology to digitize its collection, making it accessible to researchers and scholars worldwide while also preserving the physical copies for future generations.

Another example is the use of 3D printing to replicate damaged or lost artifacts, such as the reconstruction of the ancient city of Palmyra in Syria, which was destroyed by ISIS militants. Using 3D printing technology, archaeologists were able to recreate some of the city's most famous structures, preserving their historical and cultural significance (Bozorgi and Lischer, 2020; Ahmad and Sharma, 2020; Champion and Rahaman, 2019).

To address the lack of awareness and education about heritage preservation, initiatives like heritage education programs can be established to educate people about the value of heritage and the importance of its preservation (Borri and Corradi, 2019). These programs can be integrated into school curriculums, cultural events, and community outreach programs to reach a wider audience.

Overall, it is clear that collaboration among governments, institutions, and communities is essential to address the challenges posed by Industry 4.0 to heritage preservation. By leveraging technology, establishing policies and regulations, and raising awareness, we can ensure that cultural heritage is preserved for future generations.

Apart from the above, some other improvement measures are also proposed as discussed in Table 1 below including integration of technology, sustainable preservation, promote digital culture, collaboration and partnerships, as well as education and awareness.

Table 1
Other measures proposed for improvement.

Proposed Measures	Description
Integration of technology: (Cabeza, Gracia and Pisello, 2018; Elabd, Mansour and Khodier, 2021).	Technology can be leveraged to enhance the preservation of cultural heritage. For instance, digital technologies such as virtual reality, augmented reality, and 3D modeling can be used to create immersive experiences that allow people to interact with heritage sites remotely.
Sustainable preservation: (Rahman, Akasah and Zuraidi; Cinieri and Zamperini, 2013; Todorova, 2021)	Industry 4.0 has a significant impact on the physical environment, and preserving heritage sites sustainably is crucial. Governments and institutions must develop sustainable preservation strategies that consider the environmental impact of preservation efforts.
Promote digital culture: (Cinieri and Zamperini, 2013; Todorova, 2021)	The rise of digital culture offers opportunities for heritage preservation. Governments and institutions can promote the use of digital platforms to share information and knowledge about cultural heritage, making it more accessible and engaging for people.
Collaboration and partnerships: (Rahman, Akasah and Zuraidi, 2012; Akasah,	Heritage preservation requires a collaborative effort from governments, institutions, and communities worldwide. Partnerships can be established to raise awareness, develop

Abdul and Zuraidi, 2011; Mohamad, Akasah and Rahman, 2015).	preservation strategies, and secure funding for preservation efforts.
Education and awareness: (Ahmad and Sharma, 2020; Permatasari et. al., 2020; Rahman, Akasah and Zuraidi, 2012; Akasah, Abdul and Zuraidi, 2011; Mohamad, Akasah and Rahman, 2015).	Increasing education and awareness is essential to promote responsible stewardship of our cultural heritage. Governments and institutions must prioritize heritage education in schools, museums, and other public spaces to help people understand the value of cultural heritage and the importance of preserving it.

In short, preserving cultural heritage in the Industry 4.0 era requires a multifaceted approach that leverages technology, promotes sustainability, fosters digital culture, and promotes collaboration and partnerships. By working together and raising awareness, we can ensure that cultural heritage is preserved for future generations.

Conclusions

In conclusion, heritage preservation is crucial for maintaining our cultural identity, promoting tourism and economic development, supporting education, protecting the environment, and fostering community pride. With the rise of Industry 4.0, preserving cultural heritage has become increasingly challenging. However, it is essential that we address these challenges and take a collaborative approach to ensure that our cultural heritage is preserved for future generations. This requires a multifaceted approach that leverages technology, promotes sustainability, fosters digital culture, and promotes collaboration and partnerships. Governments, institutions, and communities worldwide must work together to find innovative solutions that balance the benefits of technological advancements with the importance of preserving our cultural heritage. By doing so, we can ensure that cultural heritage continues to serve as a source of inspiration, education, and pride for generations to come. Ultimately, it is our responsibility to ensure that our cultural heritage is preserved and celebrated, not only for ourselves but also for future generations.

Acknowledgement

References

Aburamadan, R., Trillo, C., Udeaja, C., Moustaka, A., Awuah, K. G., & Makore, B. C. (2021). Heritage conservation and digital technologies in Jordan. *Digital Applications in Archaeology and Cultural Heritage*, *22*, e00197.

Ahmad, A., & Sharma, S. (2020). Sustainable digital preservation and access of heritage knowledge in india: a review. *DESIDOC Journal of Library & Information Technology*, *40*(5), 321-325.

Ahmad, Y. (2006). The scope and definitions of heritage: from tangible to intangible. *International journal of heritage studies*, *12*(3), 292-300.

Akasah, Z. A., Abdul, R. M. A., & Zuraidi, S. N. F. (2011). Maintenance management success factors for heritage building: a framework. *WIT Transactions on the Built Environment*, *118*, 653-658.

Alaloul, W. S., Liew, M. S., Zawawi, N. A. W. A., & Mohammed, B. S. (2018). Industry revolution IR 4.0: future opportunities and challenges in construction industry. In *MATEC web of conferences* (Vol. 203, p. 02010). EDP Sciences.

Bec, A., Moyle, B., Schaffer, V., & Timms, K. (2021). Virtual reality and mixed reality for second chance tourism. *Tourism Management*, *83*, 104256.

Borri, A., & Corradi, M. (2019). Architectural heritage: A discussion on conservation and safety. *Heritage*, *2*(1), 631-647.

Bozorgi, K., & Lischer-Katz, Z. (2020). Using 3D/VR for research and cultural heritage preservation: project update on the virtual Ganjali Khan project. *Preservation, Digital Technology & Culture*, *49*(2), 45-57.

Cabeza, L. F., de Gracia, A., & Pisello, A. L. (2018). Integration of renewable technologies in historical and heritage buildings: A review. *Energy and buildings*, *177*, 96-111.

Cashion, D. (2015). The Vatican Library and SLU/Vatican Film Library Digitization Project. *The Catholic Library World*, *85*(3), 158.

Champion, E., & Rahaman, H. (2019). 3D digital heritage models as sustainable scholarly resources. *Sustainability*, *11*(8), 2425.

Cinieri, V., & Zamperini, E. (2013). Lifecycle oriented approach for sustainable preservation of historical built heritage. In *Boriani M., Gabaglio R., Gulotta D.(a cura di), Online Proceedings of Conference Built Heritage* (pp. 465-474).

Denis, D. J. (2019). Why do maintenance and repair matter?. In *The Routledge companion to actor-network theory* (pp. 283-293). Routledge.

Elabd, N. M., Mansour, Y. M., & Khodier, L. M. (2021). Utilizing innovative technologies to achieve resilience in heritage buildings preservation. *Developments in the Built Environment*, *8*, 100058.

Feigenblatt, O. F. (2020). The importance of historical heritage and the fallacy of the cancel movement: international case studies. *Journal of Alternative Perspectives in the Social Sciences (2020) Volume*, *10*, 483-492.

Harrison, R., DeSilvey, C., Holtorf, C., Macdonald, S., Bartolini, N., Breithoff, E., ... & Penrose, S. (2020). *Heritage futures: comparative approaches to natural and cultural heritage practices*. UCL press.

Harun, S. N. (2011). Heritage building conservation in Malaysia: Experience and challenges. *Procedia Engineering*, *20*, 41-53.

Harun, S. N., & Ismail, I. (2011). The conservation plan for world heritage site: George Town, Penang and Malacca, Malaysia. In *Proceedings of the 1st International Conference on Rebuilding Place: From Culture to Art and Architecture, University Kuala Syiah, Banda Acheh, Indonesia*.

Indrie, L., Oana, D., Ilieş, M., Ilieş, D. C., Lincu, A., Ilieş, A., ... & Oana, I. (2019). Indoor air quality of museums and conservation of textiles art works. Case study: Salacea Museum House, Romania. *Industria Textila*, *70*(1), 88-93.

Ismail, N., Masron, T., & Ahmad, A. (2014). Cultural heritage tourism in Malaysia: Issues and challenges. In *SHS Web of Conferences* (Vol. 12, p. 01059). EDP Sciences.

Jin, M., Juan, Y., Choi, Y., & Lee, C. K. (2019). Estimating the preservation value of world heritage site using contingent valuation method: The case of the Li River, China. *Sustainability*, *11*(4), 1100.

Lat, D. C., Noor, S. N. A., Rahman, N. S. A., & Razali, R. (2021). Construction industry towards IR 4.0-A review. In *AIP Conference Proceedings* (Vol. 2339, No. 1). AIP Publishing.

Lidelow, S., Orn, T., Luciani, A., & Rizzo, A. (2019). Energy-efficiency measures for heritage buildings: A literature review. *Sustainable cities and society*, *45*, 231-242.

Lim, C. K., Ahmed, M. F., Mokhtar, M. B., Tan, K. L., Idris, M. Z., & Chan, Y. C. (2021). Understanding intangible culture heritage preservation via analyzing inhabitants' garments of early 19th century in weld quay, Malaysia. *Sustainability*, *13*(10), 5393.

Mahdzar, M., Shuib, A., Ramachandran, S., & Afandi, S. H. M. (2015). The role of destination attributes and memorable tourism experience in understanding tourist revisit intentions. *American-Eurasian Journal of Agricultural & Environmental Sciences (Tourism & Environment, Social and Management Sciences)*, *15*, 32-39.

Mason, R. F., & Page, M. (2004). *Giving preservation a history: Histories of historic preservation in the United States*. Routledge.

Mei Goh, H. (2015). UNESCO World Heritage Site of Lenggong Valley, Malaysia: A review of its contemporary heritage management. *Conservation and Management of Archaeological Sites*, *17*(2), 143-158.

Mohamad, S. B. H. S., Akasah, Z. A., & Rahman, M. A. A. (2015). A review of the maintenance performance factors for heritage buildings. In *InCIEC 2014: Proceedings of the International Civil and Infrastructure Engineering Conference 2014* (pp. 177-187). Springer Singapore.

Mu'az, A., Zaidi, M. A., & Ahmad, N. A. (2021). Green technology in improving defect management model for operated heritage buildings in Malaysia–a literature review. *Journal of Islamic*, *6*(36), 11-17.

Mustafa, N. A., Abdullah, N. C., Mohamed, B., & Bahauddin, A. (2013). Preservation of cultural heritage in Malaysia: An insight of the National Heritage Act 2005. In *Proceedings of International*

Naboodah, H. M. (2011). The importance of heritage preservation. *Museum International*, *63*(3-4), 69-77.

Nilson, T., & Thorell, K. (2018). Cultural heritage preservation: The past, the present and the future.

Onyima, B. N. (2016). Nigerian cultural heritage: Preservation, challenges and prospects. *OGIRISI: a new Journal of African Studies*, *12*, 273-292.

Permatasari, P. A., Rech, M., Qohar, A. A., & Faizal, A. (2020). From web 1.0 to web 4.0: the digital heritage platforms for UNESCO's heritage properties in Indonesia. *Virtual Archaeology Review*, *11*(23), 75-93.

Petracek, P., Kratky, V., Baca, T., Petrlik, M., & Saska, M. (2023). New Era in Cultural Heritage Preservation: Cooperative Aerial Autonomy: Supervised Autonomy for Fast Digitalization of Difficult-to-Access Interiors of Historical Monuments. *IEEE Robotics & Automation Magazine*.

Kurnia, R. S. U. (2021). A systematic literature review (SLR) on the development of sustainable heritage cities in Malaysia. *Journal of Regional and City Planning*, *32*(3), 290-310.

Rahman, M. A. A., Akasah, Z. A., & Zuraidi, S. N. F. (2012). The importance of on-going maintenance in preserving the heritage listed buildings. *International Journal on Advanced Science Engineering Information Technology*, *2*(2), 83-85.

Rudokas, K., Landauskas, M., Grazuleviciute-Vilneiske, I., & Viliuniene, O. (2019). Valuing the socio-economic benefits of built heritage: Local context and mathematical modeling. *Journal of Cultural Heritage*, *39*, 229-237.

Ruhanen, L., & Whitford, M. (2021). Cultural heritage and Indigenous tourism. In *Indigenous Heritage* (pp. 1-13). Routledge.

Said, S. Y., Aksah, H., & Ismail, E. D. (2013). Heritage conservation and regeneration of historic areas in Malaysia. *Procedia-Social and Behavioral Sciences*, *105*, 418-428.

Shaharuddin, S. I., Shamsuddin, M. S., Drahman, M. H., Hasan, Z., Asri, M. N. A., Nordin, A. A., & Shaffiar, N. M. (2021). A review on the Malaysian and Indonesian batik production, challenges, and innovations in the 21st century. *SAGE Open*, *11*(3), 21582440211040128.

Shan, M., Chen, Y. F., Zhai, Z., & Du, J. (2022). Investigating the critical issues in the conservation of heritage building: The case of China. *Journal of Building Engineering*, *51*, 104319.

Sklokina, I., & Kulikov, V. (2021). Industrial Heritage and Its Multiple Uses in Donbas, Ukraine. *Region*, *10*(1), 33-60.

Spennemann, D. H., & Graham, K. (2007). The importance of heritage preservation in natural disaster situations. *International Journal of Risk Assessment and Management*, *7*(6-7), 993-1001.

Suaib, N. M., Ismail, N. A. F., Sadimon, S., & Yunos, Z. M. (2020). Cultural heritage preservation efforts in Malaysia: A survey. In *IOP Conference Series: Materials Science and Engineering* (Vol. 979, No. 1, p. 012008). IOP Publishing.

Taçon, P. S., & Baker, S. (2019). New and emerging challenges to heritage and well-being: A critical review. *Heritage*, *2*(2), 1300-1315.

Todorova-Ekmekci, M. (2021). Using Innovative Technologies, Digital Media and Site Tools For Presentation and Sustainable Preservation of Cultural Heritage. In *2021 5th International Symposium on Multidisciplinary Studies and Innovative Technologies (ISMSIT)* (pp. 135-140). IEEE.

Umar, S. B., & Said, I. (2019). Conservation Challenges of Heritage Building Reuse in Nigeria: A review of decision-making models. *Asian Journal of Environment-Behaviour Studies*, *4*(12), 16-36.

Yotsumoto, Y., & Vafadari, K. (2021). Comparing cultural world heritage sites and globally important agricultural heritage systems and their potential for tourism. *Journal of Heritage Tourism*, *16*(1), 43-61.