The role of Information Technology in the Conservation of Intangible Cultural Heritage, at Bagamoyo Tanzania.

Abstract

This study assessed the role of information technology in the Conservation of intangible cultural heritage in Tanzaniaspecifically at Bagamoyo.It assessed the role of information technology in the protection and inheritance of intangible cultural heritage and the development of information technology in the protection and inheritance of intangible cultural heritage. The study used a quantitative approach through a case study design as the framework for data collection. The study collected data from 40 respondents through questionnaire and observation guide. The data was analysed using SPSS, where frequencies and percentages as well as mean scores were computed after which tables were derived. The study found that Information technology in important in conservation of both intangible and tangible cultural heritage albeit with some challenges. Some of the important aspects of information technology in cultural heritage conservation were such as Digital documentation, analysis and restoration, enhancing accessibility, virtual and augmented reality, language and accessibility, Documentation and archiving, digitization of performances and art forms, oral history preservation, and enhancing accessibility were important aspects through which information technology is used for cultural heritage conservation. The study recommended for enhance digital documentation and archiving, increase funding and resource allocation, develop collaborative partnerships, implement community engagement programs, enhance accessibility and sharing of digital resources and leveraging mobile technology and social media.

Key Words:*Information Technology, Conservation, Intangible Cultural Heritage, Bagamoyo*

Background and Problem Statement

Cultural heritage is a term made known in the middle of the 20th century mainly by entities interested in its protection, such as the United Nations Educational, Scientific and Cultural Organization, hereinafter UNESCO, which defines it in its document resulting from the 1972 Convention for the Protection of the World Cultural and Natural Heritage held in Paris, as all tangible and intangible cultural expressions (UNESCO, 1972; Puerta *et al.*, 2021). Intangible cultural heritage is defined by UNESCO in the same document as the practices, representations, expressions, and knowledge that a country or region recognizes as part of its cultural heritage. The document further defines Tangible cultural heritage is a heritage that can be seen and touched. It includes buildings and historical sites, monuments, artefacts, and others, which are considered important and valuable to be maintained for the future (Manzhong, 2022). Furthermore, tangible cultural heritage also comprises the material remains of human activities, works, developments and achievements such as cities and towns, palaces, villages, temples, mausoleums and manufacturing plants (Huang & Chen, 20219). Tangible cultural heritage can be divided into immovable heritage and movable heritage. Immovable heritage includes historical buildings, monument, archaeological sites meanwhile movable heritage includes paintings, sculptures, furniture and wall paintings which are is usually displayed in museums or stored in archives or research centres.

Since the 1990s, information technology has made great progress. Information technology is not only widely used in various industrial fields, but also opens up a new way for cultural heritage protection (Suárez*et al.*, 2019). In addition to various industrial fields, modern scientific and

technological means have gradually been widely used in the intangible cultural heritage preservation, opening a new door and a new chapter for the development of cultural heritage protection (Kwon, 2016). Information technology in intangible cultural heritage information collection, storage, processing and cultural communication, through digital transformation, makes the damaged culture recover and lost culture reappear, adding a new perspective to interpret, on the basis of the protection of the original culture, to achieve more clarity and convenience (Yelmi, 2016). Today, with the continuous development of information technology, people gradually realize that information technology has a role beyond traditional protection and development in the protection and development of intangible cultural heritage (Chen, 2015). With the development of information technology and computer technology in recent years, as well as the development of digital storage hardware technology, intangible cultural heritage has been properly preserved through digitization. It is an inevitable trend to protect and develop intangible cultural heritage with the help of efficient digital technology (Li, 2018). With the development of information digitization technology with computer as the core, it brings a Conservation opportunity for the protection of intangible cultural heritage.

In essence, the advantages of digital technology lie in the amount and efficiency of data processing. In recent years, the development of artificial intelligence has made great progress in the understanding and creation of data content. Information technology can transform a lot of very complex information in intangible cultural heritage into measurable data, and then use these data to establish appropriate models, so as to provide a shortcut for the protection and development of Intangible Cultural Heritage (Springstubb, 2018). In developed countries, the use of digital means to protect intangible cultural heritage has just begun. Due to the imperfect management mechanism and format specification, and the special nature of intangible cultural heritage, the development of digital means is still very difficult (Li, 206). With the deepening of Tanzania's social informatization, digital protection of intangible cultural heritage is its inevitable conservation trend, and it is of great practical significance to explore the practice of its protection methods (Lv& Li, 2016). In the protection of intangible cultural heritage, the use of digital information technology means provides more possibilities and Conservation potential. In order to better protect the intangible cultural heritage, this article studies the important role of information technology in the Conservation of intangible cultural heritage in Tanzania.

Objectives of the Study

This study aimed at achieving the following objectives

i. To assess the role of information technology in the protection and inheritance of intangible cultural heritage
ii. To assess the development of information technology in the protection and inheritance of intangible cultural heritage

Literature Review

The role of information technology in the protection and inheritance of intangible cultural heritage

Information technology provides a lot of new acquisition and recording means for the protection of intangible cultural heritage, including graphic scanning, stereo scanning, holographic photography, digital photography, motion capture, etc. Information technology also provides many new protections means for the protection of intangible cultural heritage, including the effective protection of intangible cultural heritage resources through database, disk array, optical fiber and network connection, as well as a series of relevant regulations and protocols.

The application of digitization in the dissemination of intangible cultural heritage can further break the regional restrictions of intangible cultural heritage under different backgrounds, realize further communication between different cultures, ensure the objectivity and accuracy of cultural communication, and enhance the communication effect of Intangible Cultural Heritage (Chen et al., 2016). According to (Wesener, 2017) science and technology has become one of the main implementation contents of Tanzania's intangible cultural heritage protection project to use modern scientific and technological means such as digital multimedia to record, systematically and comprehensively precious, endangered and historical value intangible cultural heritage. Digital protection of cultural heritage refers to the preservation, protection and re promotion of traditional cultural resources with the help of digital technology, respecting the original form of cultural heritage under a certain cultural background.

With the development and progress of society, we must realize that the original mode of moving intangible cultural heritage into museums is out of date, and it is not conducive to the inheritance

and development of intangible cultural heritage. We must change the traditional concept of Museum database and establish a complete and comprehensive digital cloud data system by using cloud computing, cloud storage, cloud analysis, cloud playback, etc. (Manzhong, 2022). Based on the unified platform of digital media, the digital museum integrates the intangible cultural heritage information of various media forms, and spreads it by means of telecommunication, wireless communication, Internet, cable TV and various digital TV networks, breaking the restrictions of specific time and place, and making it a new application platform suitable for mass communication under the condition of modern technology (Springstubb, 2018). Due to the different levels of software and hardware, the technical standards of data collection and Conservation format adopted by Tanzania's intangible cultural heritage protection are different, which leads to data incompatibility among various protection departments. In view of the above problems, modern information technology should be adopted to match the construction of national digital library, digital museum and national cultural information resource sharing project.

Compared with the traditional protection methods, information technology protection is more suitable for the characteristics of modern society. For intangible cultural heritage which is on the verge of being lost, it can be quickly recorded and saved, so as to strive for more time for the follow-up protection and development work and slow down the loss of intangible cultural heritage. The technology system is mainly composed of digital technology of intangible cultural heritage, scene modeling and behavior control technology, resource management and service technology, and visualization technology(Huang & Chen, 20219).

Intangible cultural heritage includes traditional cultural expressions and cultural space on which it depends. Single digital storage usually ignores the characteristics of cultural space on which it depends, so it is difficult to preserve intangible cultural heritage as a whole. No matter words, music, figures and images, all kinds of cultural contents gradually form global shared cultural resources in the process of intercommunication and mutual dissolution with the help of digital media, thus promoting the spread of cultural achievements around the world and truly being recognized and accepted(Huang & Chen, 20219). The emergence of digital technology, using new scanning and digital photography technologies, can not only provide efficient information collection of intangible cultural heritage, but also transform existing textual and image data into

digital storage. Thus, the protection of intangible cultural heritage can be carried out smoothly and for a long time. Modern digital information acquisition and processing technology can better sort out, collect and record the information of intangible cultural heritage, break through the display requirements and fidelity effects that traditional protection methods cannot achieve, and preserve this precious intangible cultural heritage more safely and for a long time. The emergence of digital technology, using new scanning and digital photography technologies, can not only provide efficient information collection of intangible cultural heritage, but also transform existing textual and image data into digital storage(Manzhong, 2022). Thus, the protection of intangible cultural heritage can be carried out smoothly and for a long time.

In the final analysis, the difficulty of inheriting intangible cultural heritage is due to the change of production mode and living environment, while maintaining the original production mode, life style and even living environment is in conflict with the modernization goal of all mankind. Intangible cultural heritage will be influenced by natural environment and social environment as time goes by. With the continuous development of digital technology, these effects can be minimized (Puerta *et al.,* 2021). By using digital image art, history can be reproduced, and the process of the emergence, application, development and change of a certain intangible cultural heritage in history can be displayed through digital images, which can reproduce the lifestyle and state of people in different times under the influence of this intangible cultural heritage, and restore the historical and cultural background of intangible cultural heritage projects. Inheriting intangible cultural heritage can digitize traditional intangible cultural heritage resources and make them into visual virtual products for people to learn, exchange and innovate in intangible cultural heritage knowledge. Digital technology promotes the dissemination of intangible cultural heritage. The digitalization of intangible cultural heritage is to simulate the real scene of traditional culture through information technology and make it virtualized (Ott *et al.,* 2015). The application of digitalization in the inheritance of intangible cultural heritage not only provides the audience with the opportunity to reinterpret intangible cultural heritage, but also stimulates people's cultural consciousness and makes more people take the initiative to join the inheritance of intangible cultural heritage.

Digital technology has played an important role in the protection and inheritance of intangible cultural heritage, but its utility has not yet been fully developed. With the development of

information technology, digital technology will play a greater role in the protection, inheritance and development of intangible cultural heritage. The real value of intangible cultural heritage lies in its rich cultural factors, which can be transformed into excellent cultural products with unique national style and local characteristics by means of production, circulation and sales, so that it can be reintegrated into the real society and enter people's daily life (Puerta *et al.*, 2021). There are essential differences between material and intangible cultural heritage in visualization technology. The former can be presented in the form of pictures, videos and animations. The latter's digital visualization is more of a knowledge visualization category, and its visualization forms are more focused on displaying cultural connotations. With the progress of science and technology and the development of digitalization and Informalization, these key technologies will be overcome and high-end equipment will be manufactured, which will greatly improve the productive protection ability of intangible cultural heritage.

The development of digital technology in the protection and inheritance of intangible cultural heritage

Intangible cultural heritage has been passed down through long-term practice and can represent a local culture, which includes various traditional cultural expressions and cultural spaces closely related to people's lives. After digital promotion and inheritance, people have a more comprehensive and in-depth understanding of intangible cultural heritage, and some intangible cultural heritages have more audiences(Huang & Chen, 20219). More and more people begin to accept them, learn from them and finally apply them. Intangible cultural heritage, which has undergone historical screening and passed down through long- term practice, can represent the culture of a region or even a nation. It is closely related to people's lives and has rich connotations. Using digitalization to record and store these cultural heritages, and simply presenting them in the form of texts, images, audio and video, it is difficult for users to fully express some cultural connotations (Yalçinkaya, 2015).Single digital storage ignores the unique cultural space characteristics among different cultures. Therefore, it is necessary to build a technical system for the protection and inheritance of intangible cultural heritage, in which digital technology, scene modeling technology and visualization technology are combined. The digital transformation of intangible cultural heritage breaks through the limitation of regional

space, which helps the inheritors to integrate intangible heritage with practical needs, and makes it easier for the public to understand and accept.

Based on the liveness, tradition and integrity of intangible cultural heritage, and on the basis of detailed analysis and research on the systematic, complex and implicit characteristics of its knowledge, this paper explores the constituent elements of intangible cultural heritage knowledge from the perspectives of folklore, sociology, anthropology, aesthetics, history and psychology, and extracts the characteristics of knowledge and makes a summary of it. Intangible cultural heritage is easy to be digitized, networked and virtualized, and can be used to build interactive and open large- scale digital museums of intangible cultural heritage, audio-visual works, interesting games, virtual situations and industrial design products, and share the global resources by means of the Internet(Huang & Chen, 20219). Using digital virtual reality technology to realize the development and utilization of intangible cultural heritage, industrial production and management is conducive to the formation of new industries and derivative products, extending the industrial chain and increasing the proportion of cultural industries.

In the digital development of intangible cultural heritage, the existing problems focus on the technical difficulties of interactive production of three-dimensional scenes of cultural activities and role animation. By applying digital technology to the protection of intangible cultural heritage, the traditional moral spirit can be presented from a brand-new perspective by digital means, which breaks through the limitation of time and space, expands the scope of communication, and makes the audience better nourished by traditional culture in the process of imperceptible influence (Springstubb, 2018). In practical work, high-quality digital technical talents are scarce, which leads to the failure to give full play to the effect that digital technology should have achieved. Symbolization of intangible cultural heritage provides a way to transform cultural heritage resources into cultural capital (Artese & Gagliardi, 2015). We should provide realistic character models for the production of intangible cultural heritage inheritors' character animation by using the real touching character model creation technology, and generate character action animation efficiently by using the action data in the resource library. Finally, by means of knowledge, behavior modeling and interaction, the visual production of intangible cultural heritage resources is realized, effective interaction is realized on the built platform, and visual product communication is promoted. In the protection of intangible cultural heritage, digital

technology should be actively used to make intangible cultural heritage form its own characteristic culture on the basis of protection and inheritance, thus creating greater economic and social benefits, improving Tanzania's international status and promoting faster and better economic development.

Methodology

This study employed a case study design as the framework for data collection and analysis because it is a better way of intensive examination of a single case (Bryman, 2012) The study was done at Bagamoyo, one of the richest cultural heritage towns in Tanzania with a lot of historic backgrounds including buildings such as forts, temples, landscapes, objects, and buildings (Lerise F., 2004). Bagamoyo is famous through historical, cultural and tourist sites such as Kaole ruins, the exit point of the body of Dr David Livingstone, the Old Boma, the Catholic Museum which is one of the oldest Cathedrals in Africa, and the exit point of slaves and ivory. The study sampled 40 respondents comprised of twenty (20) local community members, ten (10) respondents from government institutions like TANAPA, TAWA and TFS, and ten (10) respondents from different cultural heritage resources Conservation stakeholders. This study employed non-probability sampling strategies which allowed the researcher to select the respondents who suited the study deliberately (Kothari, 2004). The respondents were selected by using purposive sampling particularly, snowball sampling and generic purposive sampling. Data was collected through structured questionnaires that had a series of questions that covered the topic. The collected data were processed and analysed through SPSS through which frequencies and percentages were computed.

Findings

The role information technology in preserving intangible cultural heritage

Intangible cultural heritage (ICH) refers to practices, representations, expressions, knowledge, and skills that communities, groups, and individuals recognize as part of their cultural heritage. These include oral traditions, performing arts, rituals, festivals, and traditional craftsmanship. With globalization, urbanization, and technological advancements, many forms of ICH face the threat of extinction. However, information technology (IT) has emerged as a powerful tool in

safeguarding and promoting ICH by ensuring its documentation, dissemination, and accessibility. In this part, the study first focused on the awareness of participants as to the role of information technology in preserving intangible cultural heritage for which the findings are presented hereunder.

Table 1: Summary of respondent's awareness on applicable information technology tool

Response Option	Respondent Group	Feedback Summary
Yes	Experts such as Archaeologists, Conservationists, Urban Planners)	High awareness of various ICT tools.
	Heritage Managers	Moderate to high awareness.
	Local Government Officials	Moderate awareness.
	Tourism Professionals	Moderate awareness.
No	General Public	Low to moderate awareness.

The findings are presented in Table 1 revealed that the category of Experts was generally well-informed about information technology tools used in conservation as they are familiar with a range of tools and their applications in Bagamoyo, recognizing their impact on preserving cultural heritage. They may provide specific examples and detailed feedback on how these tools are used. Experts are generally well-informed about information technology tools like GIS, 3D modelling, drones, and digital archiving. They recognize how these tools are employed in preserving Bagamoyo's cultural heritage. They often discuss specific applications and benefits.

Heritage Managers were aware and their awareness level were rated to moderate to high awareness as they understand the practical applications of information technology tools like GIS and digital archiving in managing and preserving heritage sites but may not have comprehensive knowledge of every tool. Heritage managers are aware of some information technology tools, such as GIS and digital archiving, and understand their applications in conservation but may not be familiar with all tools or their full capabilities.

Local Government Officials were aware, and their level of awareness were rated to moderate awareness as they were familiar with the use of some information technology tools in planning and monitoring but might not be fully updated on all available tools and their specific uses in heritage preservation. Officials are aware of tools like GIS and drones, especially in planning and

documentation, but might not be fully informed about all tools and their detailed uses in heritage preservation.

Tourism Professionals were aware, and their level of awareness were rated to moderate awareness as they are aware of information technology tools that enhance visitor experience and public engagement but may not have detailed knowledge of their application in conservation efforts. Tourism professionals know about the use of information technology tools for enhancing visitor experiences and conservation awareness but may not be fully aware of the tools used specifically for preservation. The general Public werelow to moderate awareness**,** and their level of awareness were ratedtomore common to be unaware as the public often lacks detailed knowledge about specific information technology tools used in preservation. Their awareness might be limited to general information presented in public campaigns or tourism materials. The public might be aware of some information technology applications in cultural heritage through public campaigns or tourism information but often lacks detailed knowledge of specific tools or their roles in preservation.

Generally, Awareness of information technology tools for preserving Bagamoyo's cultural heritage varies significantly among different respondent groups. Experts and heritage managers generally have a higher level of awareness and understanding of these tools. In contrast, local government officials, tourism professionals, and the general public show varying levels of awareness, with the general public often having the least detailed knowledge. Increasing awareness and education about information technology tools across these groups can enhance their effectiveness in preserving cultural heritage.

Table 2: Preserving cultural heritage using Information Technology

Question items	Strongly Disagree		Disagree		Neutral		Agree		Strongly Agree		Mean
	F	%	F	%	F	%	F	%	F	%	
Documentation and Archiving	45	31.0	42	29.0	16	11.0	22	15.2	20	13.8	4.52
Digitization of Performances and Art Forms	18	12.4	42	29.0	24	16.6	43	29.7	18	12.4	4.95
Oral History Preservation	19	13.1	44	30.3	24	16.6	41	28.3	17	11.7	3.76
Enhancing Accessibility	32	22.1	46	31.7	22	15.2	33	22.8	12	8.3	3.63

The Table 3 on the survey of the role of information technology in preserving cultural heritage at Bagamoyo, revealed that information technology is very important in cultural heritage conservation. Mean scores of Statements 1, and 4, show high agreement (mean scores 4.52 and 4.95) with the ideas that information technology is important for documenting and archiving and digitization of performances and art form of cultural heritage respectively. Statement 3 posted a more moderate agree perspective with a mean score of 3.76, suggesting that participants were well conversant with means to how information technology can help preserve oral history. Similarly, statement 3 had a mean score of 3.76 highlighting that information technology is influential in preserving cultural heritage through enhancing accessibility of such information.

These findings are in conformity with those of a study by Alivizatou et al. (2020) who asserted that Information technology plays a crucial role in the digital documentation of intangible cultural heritage, which often relies on oral transmission or ephemeral performances. Through the use of advanced tools like audio and video recording, digitization of manuscripts, and 3D modelling, traditional practices can be preserved for future generations.

In the same vein, the findings reflect the study byChang and Lee (2020) highlight the potential Technologies like high-definition video recording, motion capture, and virtual reality (VR) enable the capture of performing arts such as dance, theatre, and music, which are central to many cultural traditions. These performances can be archived in digital libraries, providing permanent records for future generations to access and learn from.

The above findings agree with those of a study by Chen et al. (2017), which revealed the effectiveness of interactive mobile applications in teaching folklore and mythology to students, enhancing their understanding and appreciation of intangible heritage. Oral traditions, such as storytelling, chants, and dialogues, can be recorded and stored in retrieval systems.

Conclusion and Recommendations

The research on the useful application and roles of science and technology in salvaging critically endangered and threatened built heritage assets in Tanzania, with a specific focus on Bagamoyo District, highlights the transformative potential of digital and technological tools in heritage preservation. Bagamoyo, a town with rich historical significance, exemplifies the urgent need for innovative strategies to protect its built heritage from the challenges posed by natural decay,

urbanization, and climate change. Science and technology have become indispensable in modern heritage conservation efforts. Technologies such as Geographic Information Systems (GIS), 3D laser scanning, photogrammetry, and digital archiving play a vital role in documenting, monitoring, and managing heritage sites. In Bagamoyo, these tools have enabled detailed mapping of historical structures, which aids in understanding the extent of deterioration and planning targeted conservation efforts. The application of these technologies ensures that even as physical structures face threats, accurate digital records are maintained for future restoration and research.

The study recommends forutilization of digital documentation tools such as 3D laser scanning, photogrammetry, and Geographic Information Systems (GIS) to create accurate and detailed records of heritage assets in Bagamoyo. Digital documentation provides a comprehensive record of heritage sites that can be used for restoration, research, and education. It also serves as a backup in case of further deterioration or loss of physical structures. Develop and implement training programs for local professionals, heritage managers, and community members on the use of advanced technologies in heritage conservation. Building local capacity ensures that there are skilled personnel available to operate, maintain, and innovate with new technologies. Training should focus on practical skills, including the use of digital tools for mapping, condition assessment, and data management, to enhance the sustainability of ICT initiatives. It furtheradvocates for increased funding from both governmental and non-governmental organizations dedicated to heritage preservation, particularly for projects that integrate science and technology. Adequate funding is crucial for acquiring, deploying, and maintaining advanced technological tools. Additional resources will support comprehensive documentation, conservation, and community engagement initiatives, ensuring that Bagamoyo’s heritage is preserved for future generations

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