



Faculty of Cognitive Sciences and Human Development

**A Framework for Digital Transformation: Measuring the Digital
Readiness Index of Malaysian Museums**

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A Framework for Digital Transformation: Measuring the Digital Readiness
Index of Malaysian Museums

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DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Malaysia Sarawak. Except where due acknowledgements have been made, the work is that of the author alone. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.


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ABSTRACT

Museums are crucial custodians of cultural, historical, and artistic heritage, granting access to insights from bygone eras. While many Malaysian museums aim to leverage digital technologies for relevance and visitor satisfaction, empirical evidence reveals challenges hindering effective adoption, impacting museum growth and tourism. Museums are struggling to kick-start their digital transformation journey, unsure of where to begin in the face of various challenges and complexities. Therefore, the absence of a structured framework poses a critical challenge for Malaysian museums seeking to embark on digital transformation, lacking a systematic approach to assess their current digital transformation state and identify pivotal components or sectors for targeted change. This study adapted the Digital Readiness Questionnaire (DRQ) using content validation, then systematically evaluated and computed the Digital Readiness Index (DRI) for museums in Malaysia, functioning as a tool for assessing the digital transformation status and directions on how to embark on the digital transformation within the museum sector. The findings offer significant insights for researchers and museum management, providing a nuanced understanding of key aspects of digital transformation requiring heightened attention and collaboration.

Keywords: Digital readiness, digital transformation, digital technologies, museum

Rangka Kerja untuk Transformasi Digital: Mengukur Indeks Kesediaan Digital Muzium-Muzium Malaysia

ABSTRAK

Muzium ialah penjaga penting warisan budaya, sejarah dan seni, memberikan akses kepada cerapan dari zaman dahulu. Walaupun muzium-muzium Malaysia bertujuan untuk memanfaatkan teknologi digital untuk kerelevanan dan kepuasan pelawat, bukti empirikal mendedahkan cabaran yang menghalang penggunaan yang berkesan, memberi kesan kepada pertumbuhan muzium dan pelancongan. Muzium sedang bergelut untuk memulakan perjalanan transformasi digital mereka, tidak pasti dari mana untuk bermula dalam menghadapi pelbagai cabaran dan kerumitan. Oleh itu, ketiadaan rangka kerja berstruktur menimbulkan cabaran kritikal bagi muzium Malaysia yang ingin memulakan transformasi digital, kekurangan pendekatan sistematik untuk menilai keadaan transformasi digital semasa mereka dan mengenal pasti komponen atau sektor penting untuk perubahan yang disasarkan. Kajian ini mengadaptasi Soal Selidik Kesiediaan Digital (DRQ) menggunakan pengesahan kandungan, kemudian menilai dan mengira Indeks Kesiediaan Digital (DRI) secara sistematik untuk muzium di Malaysia, berfungsi sebagai alat untuk menilai status transformasi digital dan arahan tentang cara memulakan digital. transformasi dalam sektor muzium. Penemuan ini menawarkan pandangan yang signifikan untuk penyelidik dan pengurusan muzium, memberikan pemahaman yang bernuansa tentang aspek utama transformasi digital yang memerlukan perhatian dan kerjasama yang lebih tinggi..

Kata kunci: *Kesediaan digital, tranformasi digital, teknologi digital, muzium*

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LIST OF ABBREVIATIONS

CGS	Centre for Graduate Studies
UNIMAS	Universiti Malaysia Sarawak
CV	Content Validity
CVI	Content Validity Index
DRQ	Digital Readiness Questionnaire
DRI	Digital Readiness Index

CHAPTER 1

INTRODUCTION

1.1 Study Background

Museums are one of the popular tourist destinations for learning about a country's cultures and traditions. Based on the author's findings, the roles played by museums can be categorized into five, which are social (Sandell, 1998; Scott, 2006; Huang & Liem, 2022), education and source of knowledge (Andre et al., 2016; Padzi & Bahauddin, 2019), collecting and preserving collections (Padzi & Bahauddin, 2019), agent of economic (Padzi & Bahauddin, 2019; Huang & Liem, 2022), as well as agent of change and development (Padzi & Bahauddin, 2019; Huang & Liem, 2022). As ICOM(2022) mentioned that museum is known as a not-for-profit institution, but there are some researchers (Padzi & Bahauddin, 2019; Navarrete, 2019) shared that museums also can act as an agent of economic because museum attracts as well the interest of tourists visiting the museum which will enhance the number of visitors in the tourism country. This can be supported by the tourism performance report of tourism Malaysia (My TourismData, 2020), where visiting museums (38.5%) is one of the main activities engaged by the tourist around the world.

As most industries now are adopting digital technologies, museums have also adopted digital technologies to improve workflow and visitor experiences. Several museums have used digital applications to create new products and services such as online exhibitions, new processes for researching, displaying, and managing collections, new organizational structures to accommodate an increasingly digital environment, reaching new markets, and engaging into existing resources to generate new funds (Navarrete, 2019). The funds can be

used for future implementations to improve the museum performance and providing a better visitors' experiences.

The types of digital technology used to enhance user experience while visiting the museum are mobile, multimedia elements, Kinect, headset, touchscreen, and tabletop (Shah & Ghazali, 2018). The current digital technologies implemented in some museums are Augmented Reality (AR) and Virtual Reality (VR). Museum collections are digitized to be displayed in AR and VR where visitors can experience a different way of acquiring the culture and traditions of a country. Converting museum collections, as well as digitalising the workflow in the museum, leads to digital transformation. Tim and co-researcher (2020) define the digital transformation of the museum as the process of affecting significant changes to a museum's organizational system as well as long-held identity through the composition of information, computing, communication, and connectivity technologies. They state that the potential advantages of museums adopting digital transformation are enormous. The outbreak of the Covid-19 pandemic has accelerated museums' adoption of digital technologies and digital transformation to remain relevant throughout the pandemic and afterwards.

Due to the acceleration of museums adopting digital technologies, there were challenges faced by the local museums, which are technical and infrastructure issues (Abd Manaf, 2007; Fauzi et al., 2022; Ong et al., 2023; Abd Rahman et al., 2023), lack of human resources and skills (Abd Manaf, 2007; Fauzi et al., 2022; Ong et al., 2023; Abd Rahman et al., 2023), financial issues (Abd Manaf, 2007; Fauzi et al., 2022), as well as issues in museum collections management (Abd Manaf, 2007; Fauzi et al., 2022; Ong et al., 2023; Abd Rahman et al., 2023). According to Parviainen et al. (2022), the digital transformation model can

handle the company's digitisation changes. In the journey of digital transformation, there are few stages required, which are awareness, readiness, planning and executions (Aras & Büyüközkan, 2023). The readiness stage consists of the digital maturity model and assessment before planning the digital transformation roadmap of the organization. As most museum articles have discussed the benefits along with the challenges occurred when adopting digital technologies to enhance their operations and visitor experiences, they have yet to have articles studying on the digital readiness of museums in Malaysia in the journey to achieve digital transformation. Thus, the author aims to determine the digital readiness of museums in Malaysia and the results can acts as an initial stage of the journey of museums in Malaysia to undergo digital transformation.

1.2 Problem Statement

Referring to the articles related to the museums in Malaysia, there are few problems faced by the museums in achieving their goals in enhancing the performance of museums to provide a wholesome experience to the public. The author found a local report and few articles discussed about the issues and challenges faced by museums. The problems faced by museums in Malaysia are the relation of museums with economy and the issues caused by undergo digitisation and digitalisation.

The issues faced by museum in relation with economy are the hindering the industry growth and economic recovery due to poor management of museums and lack of collaborations with private sectors (Ministry of Economy, 2021). A news article shared in SER (2020) research depicts tourism is one of the major contributors to the success of the economic in Malaysia. As museums is under cultural heritage tourism, this explains the museum play a role in impacting the country's economy. SER (2020) also shared the

challenges that museums in Malaysia faced are financial constraints and poor maintenance, static and traditional exhibition method, absence of masterpieces / must-see-collections, low visitor numbers, as well as lack of effective marketing and promotional strategies.

To solve the issue mentioned in the plan, the Twelfth Malaysia plan suggested the museums to utilise technology to provide better experiences and adopt digital platforms to promote the museums. Agostino and co-researchers (2022) stated that digital technology is widely acknowledged as a critical tool for museums' long-term sustainability. With the adoption of technologies, digitisation, and digitalisation occurs. As COVID-19 happened, it became a catalyst that accelerated the adoption of digital technologies in museums due to the pandemic lockdown. This acceleration has pros and cons when undergo digitisation and digitalisation.

Based on the authors findings, there are few local articles that highlighted the issues and challenges faced by museum when undergo digitisation and digitalisation (Table 1.1).

Table 1.1: The issues and challenges faced by museums

Source	Issues and Challenges Faced by museums
Abd Manaf (2007)	standard and technical issue, limited knowledge / skill base, insufficient fundings, intellectual property issues, limited technology base, content management issue, limited infrastructure, and insufficient commitment from top management
Fauzi et al. (2022)	infrastructure: connectivity, human resources, expertise, hardware/software and budget
Ong et al. (2023)	skill fade due to pending of fundings for managing staff or

Table 1.1 continued

	availability of equipment, data integrity relates to the incorrect information when digitising the collection, the need of data sharing, storage along with integration platform for museum collaboration and researchers, as well as the data heterogeneity leads to the need of adopting database management system.
Abd Rahman et al. (2023)	loss of expertise in traditional artifacts preservation method in museums (focus more on the digitizing the artifacts and cannot replace the traditional preservation method which unable to preserve and restore the physical artifacts), digital data are hard to maintained and preserve due to the evolving of technologies, ethical and legal considerations, and limited infrastructure to use technologies.

In addition, Parviainen et al. (2022) shared that the digitisation changes faced by a company can be managed by using a digital transformation model. Tim et al. (2018) shared that digital transformation is not only investing on latest technologies but also required a complete restructure of strong organisational structures, operations and even identity. The museum challenges mentioned in Table 1.1 does not focus solely on the technology's issues but also the human resources issues, financial issues, and management issues, which similar to the dimensions highlighted by digital transformation.

These dimensions can act as a strategy or guideline in helping museum achieving digital transformation in museums. Besides that, it can also act as an assessment tool to study the current state of museums in the journey to achieve digital transformation. This

assessment tools is known as the digital maturity or digital readiness assessment. Assessing the readiness for digital transformation can assist museum managers in focusing their efforts and internal resources (Agostino & Costantini, 2022). Based on the digitisation state of museums in Malaysia, it shows that museums have started undergoing digitization way before 2007 where some local articles learn about the digitization of museums in Malaysia through survey (Abd Manaf, 2007), literature review (Salleh & Bushroa, 2022) or literature review and case studies on museums that adopt technologies (Fauzi et al., 2022). However, there are yet to have articles that discuss on the digital readiness of museums in Malaysia to achieve digital transformation. To add on, the author found that the articles that discussed about the digital readiness of museums were mainly published to study the case of museums in Italy. According to Fauzi et al. (2022), growing technologies should be used wisely to benefit the museum sector and other future industries' continuity and relevance. As a result, they suggested that an in-depth study to be conducted to assess the digital readiness of Malaysian museums.

Thus, the author seeks the suitable digital readiness questionnaire to determine the digital readiness of museums in Malaysia. As there are only digital readiness questionnaire proposed by the Italian researchers, the author validated the suitability of the digital readiness questionnaire and used the adapted questionnaire to determine the digital readiness of museums in Malaysia.

1.3 Research Questions

In this research, the researcher aims to determine the digital readiness of museums in Malaysia to learn about their readiness for digital transformation. Thus, the researcher developed two research questions, which are:

- How to evaluate digital readiness of museums in Malaysia?
- What is the digital readiness index score of museums in Malaysia?

1.4 Objectives

The research aims to study the digital readiness of museums in Malaysia to achieve digital transformation. Thus, the general objective of this study is later divided into two specific objectives, which are:

- To validate the suitability of adopted digital readiness questionnaire for evaluating the digital readiness of museums in Malaysia.
- To determine the digital readiness index score of museums in Malaysia.

1.5 Scope of Study

Since the end of 2019, most articles have been on strategies for museums to remain relevant throughout the epidemic. Fortunately, the Covid-19 vaccine has decreased the number of cases, allowing most nations to reopen for tourist entry. During the rehabilitation, new obstacles and chances will present themselves. Some articles depict museums that adopted digital technologies to solve their obstacles and adapt to the changes.

According to Abdul Wahid & Mat Isa (2022), museums in Malaysia are categorised into five types of museums, namely federal museums, state museums, private museums, department museums and institutional or university museums. As there are a total of 209 museums in Malaysia (Kaur, 2022), it is impossible to cover the digital readiness of all museums in achieving digital transformation. This study only covers museums that have responded to the survey, which is a total of 100 museums. To enhance the visitor

experiences, most museums in Malaysia adopted digital technologies but there are no specific reports on the readiness of museums in Malaysia to achieve digital transformation.

Therefore, the author validates the adopted digital readiness questionnaire (DRQ) proposed by Agostino and Costantini (2022) to adapt the questionnaire to measure the digital readiness of museums in Malaysia. The survey questions used in case studies are the adapted DRQ for determining the digital readiness of museum in Malaysia. The data collected will be analysed and aid in enhancing the local museums. Ideally, the results serve as a guide for museum managers for picture the readiness of museums in term of five dimensions to achieve digital transformation and enable future researchers to suggest a more effective strategy for the museum industry to provide sustainable services despite focusing on the adopted digital transformations.

1.6 Definition of Terms

The terms related to this research are museum, digital transformation, and digital readiness. According to ICOM (2022), museum is defined as a permanent, nonprofit institution dedicated to serving society that conducts studies on, gathers, conserves, interprets, and displays both tangible and intangible history. Museums encourage diversity and sustainability by being accessible, inclusive, and open to the public. They engage communities in their operations and communication while acting ethically and professionally and providing a variety of opportunities for learning, fun, reflection, and information sharing.

The next term, digital transformation is known as a process designed to enhance an entity by causing significant changes in its properties via information, computing, communication, and connectivity technologies (Vial, 2019).

As for digital readiness, it is explained as the level of readiness that a company has for changing how it operates digitally. This degree reflected its digital resources, its capacity to seize opportunities and coordinate these resources, as well as the dedication of all of its members to digital transformation (Nguyen et al., 2019).

1.7 Significance of Study

The findings of this research provide significant impacts on the researchers along with the museum industries. One of the significant impacts is to acknowledge the digital readiness of museums in Malaysia. Aside from that, the result of the digital readiness questionnaire (DRQ), digital readiness index (DRI) allows museum managers to acknowledge which dimension to focus on to improve or enhance the services for museum visitors. The new museums' goals can be derived from the museums' digital readiness findings. On top of that, it can contribute to the strategies stated in the first theme of the Twelfth Malaysian Plan (2021-2025), which are maximizing the potential of the creative Industry and re-energizing the tourism industry. This is because the DRQ touches not only on the technology dimension as well as the people dimension (can see whether the museum collaborates with the private sector on managing their digitized operational process), process dimension, customer dimension, as well as strategy and investment, which allow researchers, museum managers as well as private sectors (IT companies) to view the current situation of the museums before planning on digitization projects.

1.8 Chapter Summary

This chapter gives a brief idea of the problem faced by museums in Malaysia and the researcher conducting a digital readiness survey to determine the digital readiness index of museums in Malaysia in achieving digital transformation. This study benefits the

researchers, museum managers and private sectors to view the current digital readiness of museums and acknowledge the dimension that needs to be focused on.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview

This chapter will present articles relate to the research and were divided into four subtopics, which are ‘museums’, ‘Digitisation, Digitalisation and Adopted Digital Technologies in Museums’, ‘digital transformation of museums’, as well as ‘digital readiness of museums’.

2.2 Museums

Since 2007, ICOM defines a museum as “a non-profit, permanent institution in the service of society and its development, open to the public, which acquires, conserves, researches, communicates and exhibits the tangible and intangible heritage of humanity and its environment for the purposes of education, study and enjoyment” (Sandahl, 2019). However, the museum definition has changed after the Extraordinary General Assembly of ICOM has approved the proposal for the new definition (ICOM, 2022), which is:

“A museum is a not-for-profit, permanent institution in the service of society that researches, collects, conserves, interprets and exhibits tangible and intangible heritage. Open to the public, accessible and inclusive, museums foster diversity and sustainability. They operate and communicate ethically, professionally and with the participation of communities, offering varied experiences for education, enjoyment, reflection, and knowledge sharing.”

Besides, museums are places for the public to gain knowledge as well as to socialize. According to Scott (2006), the outcomes of museums benefits individuals, the economy, and

society. The impacts are divided into two, which are intermediate outcomes and long-term impacts (Table 2.1)

Table 2.1: The beneficiary of intermediate outcomes and long-term impact of Museums

Beneficiary	Individuals	Economy	Society
Intermediate outcome	• Individual learning within a specific set of circumstances • Encouragement and enjoyment	• Recruitment • acquisition of services • service enticement • earnings generated by oneself • Local economies benefit from a multiplier effect.	• Access to previous initiatives for involvement and interaction • assistance for the formal education sector • recreation facilities • acknowledgment of social problems • social integration
Long-term Impact	• gaining insights	• Restoration and advancement of cities	• Community identity • Social cohesion

Table 2.1 continued

		• municipal branding • Investment attracted by cultural credit. • A prosperous society is built on enlightened society. • Increasing community capacity through collaboration	• A yardstick for measuring progress • Increased community social and intellectual capacity • new information • a better understanding of the world we live in
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Furthermore, Grüb and Martin (2020) employed the three classifications of museum advantages put forward by Scott (2006) and carry out a case study demonstrating how Austrian residents affirm the value of museums from an individual, economic, and societal standpoint. Museums play a role in education (González-Herrera et al., 2023; Zakaria, 2023), where Andre and co-researchers (2016) research depict a museum as a place for children to acquire, and they have proposed a framework that differentiates three main types of

interactivities for enhancing strategies and activities in children's learning. Figure 2.1 illustrates the framework proposed by them.

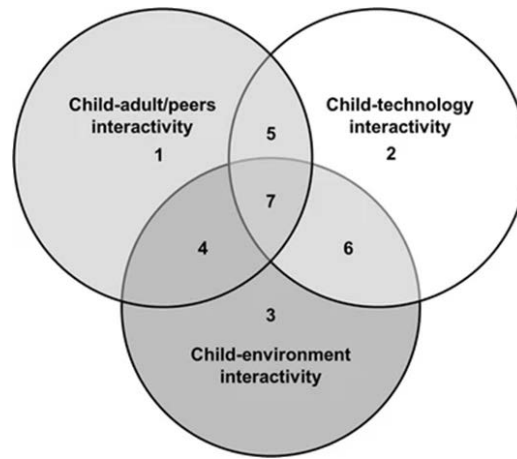


Figure 2.1: The proposed framework by Andre and co-researchers (2016).

Their research supports that museum plays a role in education and how the types of interactivities among child with adults, peers, technology or environment allow children to learn knowledge about the exhibits in the museum. Aside from their educational function, museums also serve as a social function (Zakaria, 2023). According to Sandell (1998), museums serve as agents of social inclusion and channels for broad social change by encouraging positive social change and serving as forums for public debate. Moreover, Huang and Liem (Huang & Liem, 2022) explained museums as agents of social regeneration, taking on social, economic, and political dimensions, aiming to improve individuals' quality of life while encouraging the self-improvement of marginalized groups. Apart from that, Padzi and co-researchers' findings (2019) depict that there are five roles of museums, which are listed below:

- collecting and preserving material heritage
- source of knowledge, spread knowledge, pedagogical institution.
- agents of economic

- audience-centred spaces, community meeting spaces, social enterprise
- agents of change and development

Based on the articles mentioned above, museums play several roles, and the ones that best explain the roles of museums are Padzi and co-researchers (2019). Even though museum is a not-for-profit, it acts as an agent to improve the economics due to its attraction and the interest of the tourists to increase the number in the tourism department of the country.

However, there are few problems faced by museums to stay relevant to the public. In UNESCO's report, it is reported that the main museum challenges in society are issue of globalization (mobility of collections, professionals, visitors, and ideas), relation of museums with economy and quality of life, issues museum 's social role (e.g. accessibility of museums to disadvantaged populations), as well as issue caused by the adoption of ICT in museums (Mairesse, 2019). As for Malaysia, a research article shared that the problems faced by museums in Malaysia are the financial constraints and poor maintenance, fixed and traditional method in exhibiting collections, lack of standout collections, low visitor turnout and in effective marketings (SER, 2020). In addition, the Malaysian Twelfth-Plan report shared that museum fails to attract visitors due museums' poor management and lack of collaborations with the private sectors which play a role in hindering the industry growth and economic recovery (Ministry of Economy, 2021). The plan also suggested the museum to utilise technologies to enhance experiences as well as digital platforms to promote the museums. In the past few years, innovation has emerged as a critical tool for museums to adapt to the transformative changes in the work environment (Vicente et al., 2012a). The innovation in museums can be divided into cultural innovation and technological innovation (Li & Coll-Serrano, 2019). According to two related articles (Bilton & Leary, 2002;Li & Coll-Serrano, 2019), cultural innovation focuses on creating aesthetics, symbols, or

meaning, which are typically integrated with cultural products and services and are distinguished by 'communication' value rather than functional value. In addition, technological innovation entails changes in function or use-value, which is typically an attribute in the manufacturing process, as well as its products and services (OECD/Eurostat, 2005). Technology innovations (Furferi et al., 2024; Ariza-Colpas et al., 2024) articles are highlighted more compared to cultural innovations to stay relevant in this digital era. As for this study, the technological innovations are highlighted.

2.3 Digitisation, Digitalisation and Adopted Digital Technologies in Museums

In digital era, most industries have adopted digital technologies to improve their operations and relevancy. There is significant increase of research article studying the digitisation, and digitalisation of museums (Yulifar et al., 2021; Salleh & Bushroa, 2022; Yap et al., 2024). Yulifar et al. (2021) observed a significant increase in research publications discussing digital museums, with China leading the way, having produced 148 articles related to digital museums between 1996 and 2021. As for Liao et al. (2020), the research articles on “digitization” started since 1997 to 2021 where most articles features the digitised collection as resources while for “digitalization” started since 1997 to 2021 where they features digital process in museums. According to Yulifar et al. (2021) and Ng & Hu (2024), there are a few forms of museum digitisation, which are 3D and immersive technologies (e.g. virtual and interactive museum, objects in the form of e-tangible), digital galleries, libraries, archives and museums (e.g. online/digital collections, online source material, digital exhibition) as well as social media platforms and campaigns. According to Abd Manaf (2007), digitisation in museums is not new in Malaysia, depicting museums started digitisation and utilizing digital technologies way before the pandemic. The purpose of digitisation projects was to preserve materials, support education and research activities,

enhance accessibility, share information, keep up with technology, reduce damage to original materials, and save (Abd Manaf, 2007). The process of digitised collection or management with the implementation of digital technology is digitalisation which enhances the visitors' experience (Choi et al., 2021).

Museums started using technology during the late 1960 to record collections and management (Kamariotou et al., 2021). According to Zulkifli and co-researchers (2020), a community-relevant museum's framework comprises three components: a digital platform, online learning, and cultural tourism. They claimed that digital technology is essential for visitors' experiences and for preserving and assembling the exhibition. Museums focus on visitor experience management to develop a more customer-centric perspective (Radder & Han, 2015). Past research on customer experience revealed that visitor satisfaction, memorability, and willingness to recommend or repeat the experience are all influenced by perceived experience (Rivera et al., 2015). According to Elgammal and co-researchers' findings (2020), museums have become more customer-experience oriented to attract and engage visitors, and digital technology has improved the visitor experience by comparing the visitor experience, overall satisfaction, memorable experience, and behavioural intentions of both digital museum and a traditional museum in Italy. The technologies used by museums can be divided into three types, which are online tools (e.g. websites and virtual tours to attract visitors to visit the physical museum), onsite tools (e.g. AR and VR to enhance visitor experience in museum), and miscellaneous tools (e.g. 3D printing for visitor to be engaged in learning the collections) (Fissi et al., 2022). Based on the author's finding, there are quite a number of research articles focus on using digital technologies to enhance visitors' experiences. Table 2.2 shows the examples of the three types of technologies used in museums based on past articles.

Table 2.2: Examples of the three types of technologies used in museums.

Authors	Types of technologies used in museums	Examples
Vicente et al. (2012b)	Onsite Tools	• audio-visual media (for passive presentations), • guided presentation (aided by audio guides, video projections)
Lewis (2012)	Online Tools	social media applications (for image distribution, video distribution, podcasts, microblogs, blogs, social networks, virtual worlds, and online interactive exhibits)
Narumi et al. (2013)	Onsite Tools	a digital exhibition system with includes virtual and mixed reality digital technologies to effectively deliver information about the railway train in Japan to visitors and enhance their visiting experiences (refer Table 2.3 for the types of digital exhibition and the used technologies)
Pop & Borza (2014)	Online Tools	Museum website with ticket purchasing system
Shah & Ghazali (2018)	Onsite tools	• mobile

Table 2.2 Continued

		• multimedia elements • Kinects • Headsets • Touchscreen • Tabletop
Vaz et al. (2018)	Online tools and Onsite tools	• Virtual museum consists online communication, collaboration, and social media (online tools) • Interactive kiosks and multi-touch surfaces • Mobile applications providing augmented exhibitions, museum tours and gaming experiences. Using emerging technologies (3D-printing & scanning technologies, VR, beacons (location intelligence), wearable technology (e.g. Google Glass), and tangible user interfaces (for visitor to interact physical and virtual objects at the same time) • Accessible installations for disabled visitors (apps with image and videos for

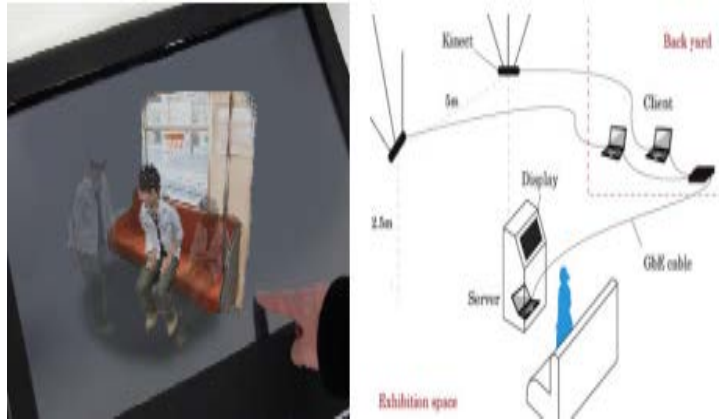
Table 2.2 Continued

		hearing- impaired or autism visitors)
Navarrete (2019)	Online tools and miscellaneous tools	• digital registration work , digital information management system (for enhancing museum management) • museum websites or third party portals (Wikimedia Commons, Google Art Project, GitHub, or social media) to access digital collections. • Google Earth or mega pixel zoom technology (allow visitors to visit the museum virtually) • Development of 2D-to-3D conversion application to produce animated figures within paintings.
Chepurda & Liubych (2020)	Online tools	• Social media (commonly used by small museums compared to big museums)

Table 2.3: The types of exhibitions and digital technologies used in the Digital Railway Museum.

Types of Digital Exhibitions	Types of Digital technologies used
Digital Display Case	3D-display in the shape of box and a pair of 3D glasses with a Polhemus sensor (for controlling the electric train in the display)  Figure 2.2: The image of a user using the “Digital Display Case” (Narumi et al,2013)
Digital Diorama: “Reminiscent Window”	A device with camera operator (tablet that use SURF-based detection)  Figure 2.3: Image of a user viewing “Reminiscent Window” (Narumi et al,2013)

Table 2.3 continued

Experience Sharing System “Time-Leaping Seat”	two depth cameras, two client PCs, a server PC, a touch panel interface, and cables to apply a real-time 3D reconstruction technique to allow visitors to see themselves in the 3D scene on display.  The figure consists of two parts. On the left is a photograph showing a person sitting on a red, cushioned seat in a museum-like setting. On the right is a schematic diagram of the system. It shows a 'Back yard' area with two Kinect sensors mounted on a wall, one at 5m and one at 2.5m. These are connected to a 'Client' PC. The 'Client' PC is connected via a 'GigE cable' to a 'Server' PC. The 'Server' PC is connected to a 'Display' unit. A person is shown standing in the 'Exhibition space' viewing the display. Figure 2.4: Image of a user viewing “Time-Leaping Seat”(Narumi et al,2013)
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The increased number of museums focuses on adopting digital technologies (online and onsite tools) to enhance visitor experiences as well as their management to stay relevant in this digital Era. However, the pandemic, COVID-19 happened which forces all industry to do digital to reduce the number of COVID-19 patients. The pandemic drives organizations to undergo digitalization (the implication of digital technologies to convert an activity or models to digital platforms) (Amankwah-Amoah et al., 2021). A few recommended approaches exist for museums to interact with their visitors during the pandemic (Table 2.4).

Table 2.4: The recommended approaches for museums during the pandemic.

Authors	Approach Recommended for museums during the pandemic
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Table 2.4 continued

Ciecko (2020)	Recommended four types of digital experiences, which are: • organizing unique campaigns and series on social media • (Twitter or Instagram) • have live streams to allow visitors to engage in real time • virtual tours • virtual and augmented reality.
Network of European Museum Organisations (2020)	Recommended a total of six types of digital initiatives: • Digital exhibitions • Online tours • Blogs, stories posted on Instagram and Facebook • Tours via live stream • Art education apps • YouTube channels with artist talks and lectures, short, fun videos of the freelancers' favorite objects/artifacts
International Council of Museums (2020)	Recommended three types of approach: • Putting museum collections online in the form of images. • Organizing virtual tours through social media such as Facebook or Instagram Live, Pinterest curated exhibitions, Twitter threads, and podcasts. Engaging museum audiences with hashtags and social media contests or quizzes.

Table 2.4 continued

Samah et al. (2021),	Suggest to adopt VR during the pandemic, (non-immersive VR
Suryani et al. (2022)	application, or VR application with 360-degree virtual tours as well as quizzes and score features)
Miłosz et al. (2022), Puspasari et al. (2021)	Suggested transforming museum display to 3D collections, using 3D scanners (Miłosz et al., 2022) or 3D blender to create a replica of the collections(Puspasari et al., 2021).

In addition, Samaroudi and co-researchers (2020) conducted a survey and listed seven types of digital offerings by museums in the UK and USA, which are Collection (Free databases exploration, Guided Exploration, Collection-related resources, 3D collection, Images databases/resources, Collecting content), Virtual Visit (Gallery Tour & Audio Tour), Learning (Educational Material), Home Activities (Creative activities & Well-being activities), Events (Festival, Live Event, Other events, Competition), Funding (Commercial venture) and Communication (COVID-19 communication, Podcast, Blog/articles' section, Social Media, Videos, Student/artist resources, Racism related, Practical info, Digital publications, Practical info, Music lists, & Other communication).

Based on author's findings, physical museums mostly adopt Virtual Reality (VR) and digital communication channels to interactive with their visitors during the pandemic. El-Said and Aziz (2022) shared museums that use VR as an alternative allowing people to visit places without getting sick, such as the New York Botanical, the Eiffel Tower, and the Vatican Museums. To add on, the Louvre Museum and Vatican Museum have applied VR during the pandemic, allowing visitors to visit the museum virtually at home(G.-S. Tan et al., 2021). The adopted digital communication channels during the pandemic allow museum

to connect with their audiences, for example YouTube, Instagram, educational channels, Twitter, Website, App, LinkedIn, Facebook, Newsletter, WhatsApp, Spotify, Radio, Podcast, TikTok, and etc (Cipullo, 2021). Raimo et al. (2022) share that social media are used instead of innovative technologies during the pandemic. Most museums used social media to interact with their audience throughout the lockdown period, where the common type of social media used by the museums are Facebook, Instagram, Youtube and Twitter (Table 2.5).

Table 2.5: Related Articles that depict museums using social media during the pandemic.

Type of social media	Authors	Museums mentioned in article
Facebook	• Agostino et al. (2020) • Tan & Tan (2021) • Hamzah et al. (2022) • Morse et al. (2022) • Stefanidou (2022)	• Italian museums • Singapore museums • Museum in Indonesia • Museum in France, Japan, Luxembourg, and United States • Museum in New York
Instagram	• Agostino et al. (2020) • Tan & Tan (2021) • Hamzah et al. (2022) • de las Heras-Pedrosa et al. (2022) • Stefanidou (2022)	• Italian museums • Singapore museums • Museum in Indonesia • Museum in Spain • Museum in New York

Table 2.5 continued

YouTube	• Tan & Tan (2021) • Hamzah et al. (2022) • Stefanidou (2022)	• Singapore museums • Museum in Indonesia • Museum in New York
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In general, the pandemic accelerates the adoption of digital technology in museums so they may engage with the public. As for post pandemic, the museums focus back on developing or adopting onsite tools to achieve their goals. Tan et al. (2021) shares that the National Museum of China, the Metropolitan Museum of Art, the British Museum, the Tate Museum, the Nation Gallery in the United Kingdom (UK), Natural History Museum (UK) and Smithsonian National Museum of Natural History (USA) used Augmented Reality (AR) technologies after the pandemic. These technologies used in the museums benefits the museum management along with their visitors (Vargun, 2022), which are:

- The technologies used in museums' internet presence have largely removed time, space, and financial constraints, providing visitors to have remote access, accessibility has increased, and the museum has a window into the world.
- The need to learn the features of new media arose fully and effectively as the digital transformation of museum have accelerated.
- It increases the time spent in the museum and its quality, provided the opportunity to use time efficiently.
- Aided in the audience's memory accumulation by providing a space for learning via experience and enjoyment.

- Attract visitors to spend more time to discover unseen details by providing a better perception of the museum collection, re-examine the collection/work, resulting in an inquiry-based rethinking of the collection.
- It allowed for the completion of the collection's missing pieces and the perception of the painting/entire object's habitat.
- It aided in bringing up-to-date exhibitions up to date and making the methods of exhibiting and presenting more appealing.
- Digital technologies have made it possible to experience history, look closely, and learn by personalizing and witnessing history.
- It has resulted in the subjectivities and liberation of those who use VR technologies to witness history.
- Technology has increased museum recognition and audience loyalty by using social media to create more intimate, rather than corporate, environments.
- Curiosity has contributed to the museum's introduction thanks to digital technologies.

These articles mentioned above showed the types of digital technologies adopted by museums throughout the years and benefit museum visitors as well as museum management in achieving their goal of enhancing the museum visitors' experiences. With the acceleration of digitisation and digitalisation in museums, there is article that share the types of physical museums in Malaysia that have adopted digital technologies (Table 2.6).

Table 2.6: The Malaysian museums that digitize and virtualize their contents.

Museums in Malaysia	Virtualization of museum collections
National Museum Malaysia	• Virtual tour on the museum website • Augmented reality app to access collections

Table 2.6 continued

	that are chosen to digitalize
Digital Cultural Heritage Gallery, UMT	• Augmented Reality Terengganu Quran manuscript
Borneo Cultural Museum	• Massive Projecting Display • Augmented Reality • Audio Visual Technology
Islamic Arts Museum Malaysia	• Virtual tour on the website
Bank Negara Malaysia Museum and Art Gallery	• Museum website that provides virtual tours and exhibition

However, like museums from other countries, Malaysian museums also faced issues when undergo digitisation and digitalisation. Based on a few articles shared the problems faced by the Malaysian Museums when undergo digitisation or digitalisation. In 2007, a survey shows that Malaysian Museums faces problem when undergo digitisation, which are standard and technical issue, limited knowledge / skill base, insufficient fundings, intellectual property issues, limited technology base, content management issue, limited infrastructure, and insufficient commitment from top management (Abd Manaf, 2007). Similar to the issue mentioned, Fauzi and co-researchers (2022) shared challenges faced by museums by reviewing literature review at case studies of Malaysian museums that adopted innovating technologies, which are infrastructure: connectivity, human resources, expertise, hardware/software and budget.

In addition, Ong and co-researchers (2023) share the challenges of digitised collections, which are skill fade due to pending of fundings for managing staff or availability of equipment, data integrity relate to the incorrect information when digitising the collection, the need of data sharing, storage along with integration platform for museum collaboration and researchers, as well as the data heterogeneity leads to the need of adopting database management system. Aside from that there are also article that share the challenges faced by museums in preservation when using digital technologies, which are loss of expertise in traditional artifacts preservation method in museums (focus more on the digitizing the artifacts and cannot replace the traditional preservation method which unable to preserve and restore the physical artifacts), digital data are hard to maintained and preserve due to the evolving of technologies, ethical and legal considerations, and limited infrastructure to use technologies (Abd Rahman et al., 2023). This subtopic shows that digitisation, digitalisation and the used of digital technologies does help museums in enhancing their management along with visitor experiences, but it also generates new problems.

2.4 Digital Transformation of Museums

The term “digital transformation” is explained as a process designed to enhance an entity by causing significant changes in its properties through information, computing, communication, and connectivity technologies (Vial, 2019). According to Parviainen et al. (2022), the digitalization changes in a company can be handle by a digital transformation model. Based on the literature review by Gebayew et al. (2018), the analysed that most research methodology based on digital transformation are conducting case study and adopt “conceptual model, framework and strategy”. They also highlighted that digital transformation benefits business, which are increase customer satisfaction and experiences,

improve productivity, increase revenue from services and products, as well as cost reduction. Furthermore, the phases of digital transformation consist of digitisation, digitalisation, and digital transformation (Verhoef et al., 2021). The researchers shared that there are three major drivers that drives digital transformation, which are digital technologies, digital competitions, and digital customer behaviour. As for Abd Hamid (2023), the researcher highlighted the types of digital transformations based on past studies, which are ‘customer experience’, ‘operational improvements’, ‘business model transformation’, ‘technology utilization’, ‘changes in value generation’, ‘structural changes’, ‘financial aspect’, ‘employee experience’, ‘a digital platform’, ‘expertise in digital technologies’, as well as ‘organization and culture’. As there is an increase of articles that are under the digital transformation topic in different fields, the author scaled down the scope of search for articles that discuss digital transformation in Museums.

Based on Scopus (Search on 22 October 2022), the graph shows the increase of digital transformation articles. there is a total of 59 articles that are related to the digital transformation museum (Figure 2.5), and most of the articles are based in Italy (Figure 2.6). Aside from that, among the 59 articles, only 20 are open access that discuss the digital transformation of museums. As for the search on 22 February 2024 and 5 July 2024, the number of digital transformation articles increases 2 times more where the trend of the related research topic started increases drastically during the pandemic. However, there are only 1 published article from Malaysia that is under the digital transformation of museum topic in SCOPUS and Web of Science. That article is about the literature review on the digital innovation in museum space (Tham et al., 2023).

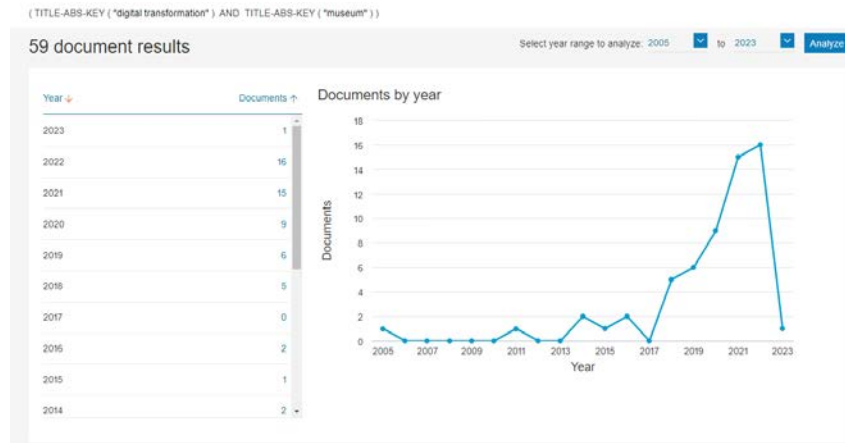


Figure 2.5: The graph of articles related to the digital transformation museum in SCOPUS.

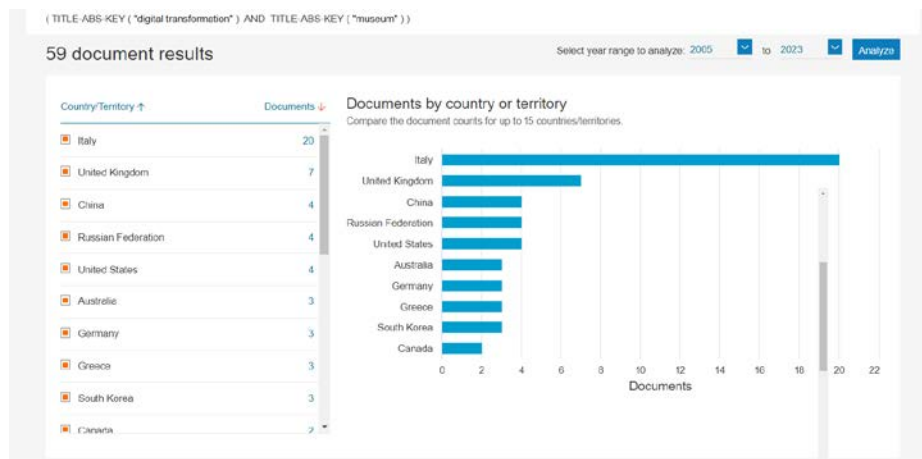


Figure 2.6: The articles related to the digital transformation museum by countries in SCOPUS.

The trend on digital transformation topics started increasing during the pandemic due to the closure of museums during the pandemic which leads to the acceleration of digital transformation in museums (Choi et al., 2021; Yap et al., 2024). This explains the findings of Liao et al. (2020) depict the number of literatures regarding digital transformation (21 articles) are lesser compared to digitization (879 articles) and digitalization (229 articles) of museums. However, they only based on one online database, Web of Science. In addition, some articles proved that Covid-19 is a catalyst for

accelerating digital transformation in museums. According to Agostino and co-finding researchers (2021) the pandemic act as an accelerator for digital transformation, and there are dilemmas arising from COVID-19 that museums should focus on when planning a digital transformation in the museum, which are:

- User engagement: What do users want, and what do museums wish to?
- Planning and control-cage or navigator?
- Digital services- fees or free?

These dilemmas challenge the digital transformation in museums. Furthermore, the restrictions imposed by COVID-19, such as the connection between the museum and the public, were affected, which has accelerated museums in planning a digital transformation and adopting suitable digital technologies to connect with the public (Cosmin & George, 2021). This acceleration allowed technology to enhance the role of museum partners, staffs, service providers and acquiring aspect of museums and an inclusive space (Yap et al., 2024). Tim and co-researchers (2018) developed a comparison table between traditional museums and museums in the digital era to understand how museums transform digitally based on their governance structure, competitiveness, and technological usage. They shared that digital transformation is not only investing on latest technologies but also required a complete restructure of strong organisational structures, operations and even identity. Based on the author's perspective, the digital transformation can be a strategy or framework to guide the museums to adapt the changes in the digital era based on different highlighted dimensions.

As mentioned in the previous subtopic, it shows that adopted digital technologies enhance the museum services and visitor experiences (Guccio et al., 2022; Khawan, 2021), but also has failures (Martínez, 2021). This shows that museums managements should not

solely focus on adopting latest technologies just to achieve the museum's goals as it will also create new challenges. The challenges in using technology in museum can be overcome if there are experts in the field of technology and possess appropriate knowledge of museum environments and the process of fostering a technological culture among museum staffs to accept the new technologies. The material element (infrastructure for implementing digital technology) in supporting the change should be highlighted as technologies with high standards and quality is very expensive. Instead of being a strategy to reduce social gaps, it lengthens the gaps when adopting the digital technologies (Khawan, 2021). Aside from that, an article depicts collaboration between museums with universities and high firms, such as Inter-Museum collaboration helps museums. Inter-museum collaboration helps museums commit to technological innovation (Li & Ghirardi, 2019). As for Leoni and Cristofaro (2022), their research shows that small museums in Italy mostly used technologies such as the website, online presence on non-proprietary channels, and social media. In addition, they have proposed a technology adoption framework based on four factors that are similar as the dimension of digital transformation, which the factors are context factors, technological factors, visitor factors, and strategic factors. Ayala and co-researchers (2019) share that museums should work on their relationship with the audiences. Their findings explored audience development in museums and other cultural heritage organizations, where it is categorized into nine categories, which are management strategies, community engagement, participation, knowing the audience, communication, marketing, education, skills and abilities as well as digital and technological environments. Based on these examples, it shows that museums need to focus on different dimensions to achieve digital transformation, such as human resources (experts and technical skills), infrastructure, collaboration, five factors framework (similar as digital transformation dimensions) and audience development.

To view the whole picture in enhancing museum services and visitor experiences, the museums need to focus on the types of digital transformation that are suitable for them to adapt to the surrounding changes so they can stay relevant in this digital era. Beyond that, some articles proposed their version of the digital transformation framework for museums. Based on the author's finding, there are 10 version of digital transformation framework proposed by researchers for museums. The Russian researchers (Hook & Kharitonova, 2017) presented a digital transformation framework for museums (Figure 2.7) to depict the three components that influence museums' changes.

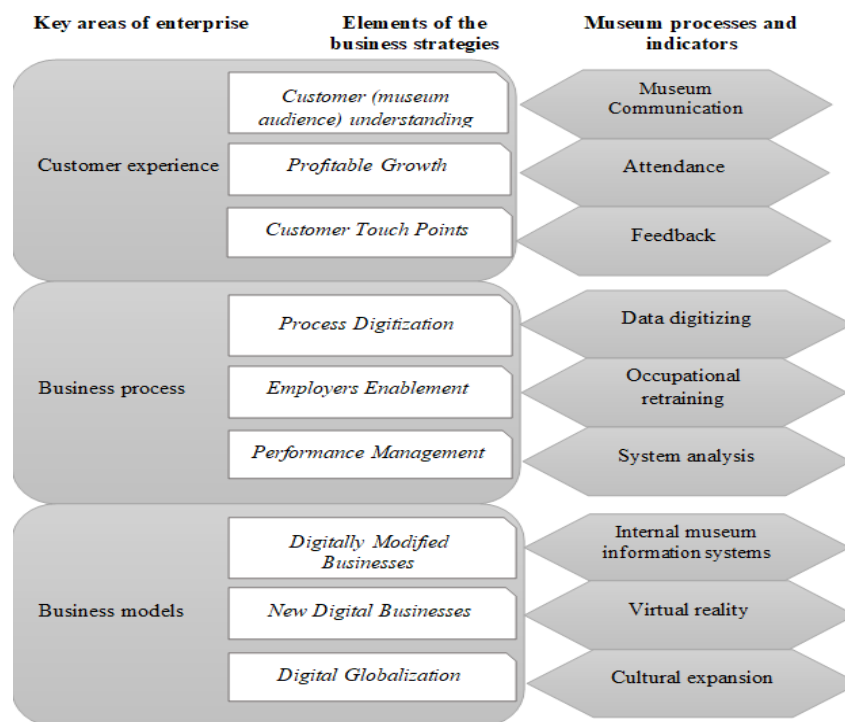


Figure 2.7: The digital transformation framework for museums proposed by Hook & Kharitonova (2017)

In the same year, an article studied the digital transformation of Portugal's tourism, where Forrester's digital maturity model (Figure 2.8) was adopted (Pereira, 2017).

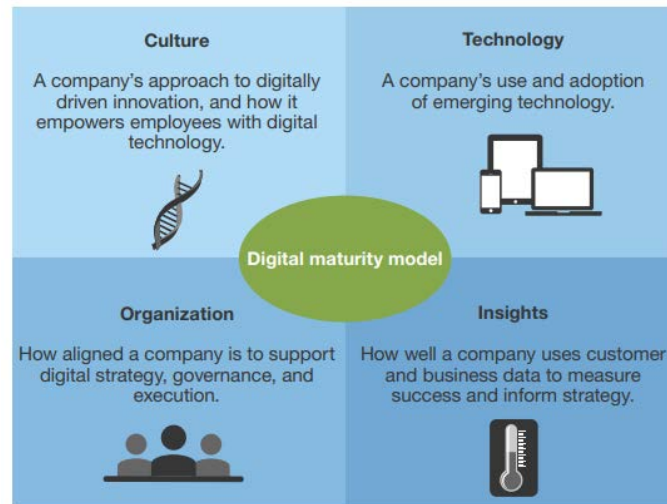


Figure 2.8: The Forrester's Digital Maturity Model proposed by (Gill & VanBoskirk, 2016).

As for De Bernardi et al. (2019) they proposed a framework. (Museums and Digital Strategies: A Three-Stage Framework) that consist of three stages to understand the current state of art as well as the point of view of the prospective managers on the digitalization of museums in Turin.

- Stage1: Unstructured Approach (Adoption of Digital Technologies Without a Specific Strategy)
- Stage 2: Partial Approach (Presence of a Digital Strategy Without Integration in the Overarching Museum Strategy).
- Stage 3: Integrated Approach (Integration of Digital Strategy Within the Overarching Museum Strategy)

Damala and co-researchers (2019) offered a different framework (Figure 2.9) that can be utilised as a tool for reflection prior to, during, and following the introduction of novel digital media resources in museums. This framework highlighted the digital technology.

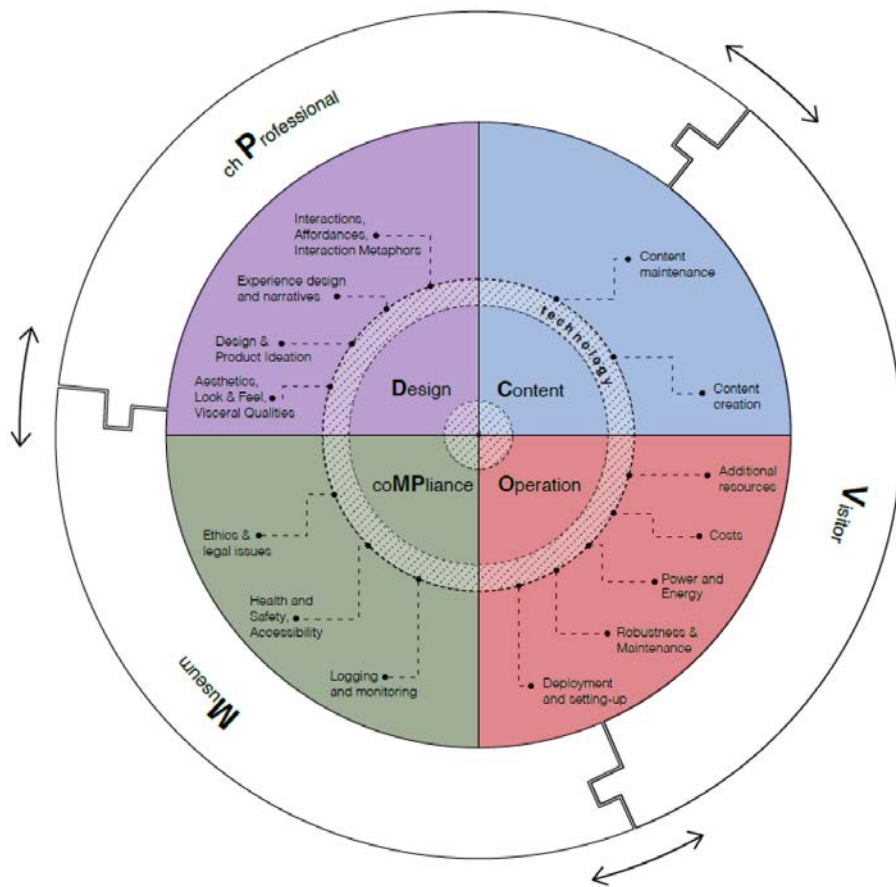


Figure 2.9: The MUSETECH Model to evaluate the museum technology.

As for Balzano (2019), a theoretical digital transformation framework (Figure 2.10) based on the findings allows museum organizations to apply the model to the project they are planning or working on to have a clear understanding of the effort of the museum and the level of advancement of the museum.

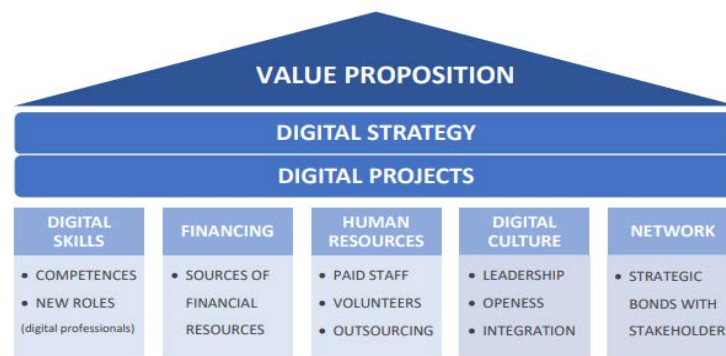


Figure 2.10: The theoretical digital transformation framework proposed by Balzano (2019) to be applied in the case study of Italian museums.

Besides that, a framework (Figure 2.11) was developed to learn about the museum’s digital transformation readiness level, where all four dimensions are the readiness of digital technologies applied in the museums (Cosmin & George, 2021). Besides, a questionnaire is provided to test the readiness of the dimensions.

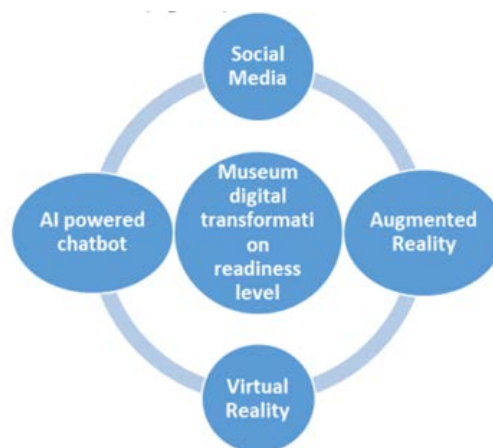


Figure 2.11: The museum digital transformation readiness level framework proposed by Cosmin & George (2021).

As for Kamariotou and co-finding researchers (2021), they proposed Tate’s digital strategy, which focuses on technology, organization, audience-centred approach, and communications (Figure 2.12).

Technology	Organization	Audience-centered approach	Communication
• Social media • Blogs • Websites • Wi-Fi	• Marketing department • Collaborative work • Training	• Digital content • Digital publications • Digital learning studios • Online courses, games, ebooks • Self-service ticketing	• Tate Kids • Tate Collectives • Tate Archives • Tate Access

Figure 2.12: Tate's Digital Strategy.

Other than focusing on the type of organization to use the suitable technology, Bocyte and co-researchers (2021) proposed a CHI Self-assessment tool concept allowing institutions to evaluate the strategies or plan against the aspects of digital transformation (Figure 2.13).

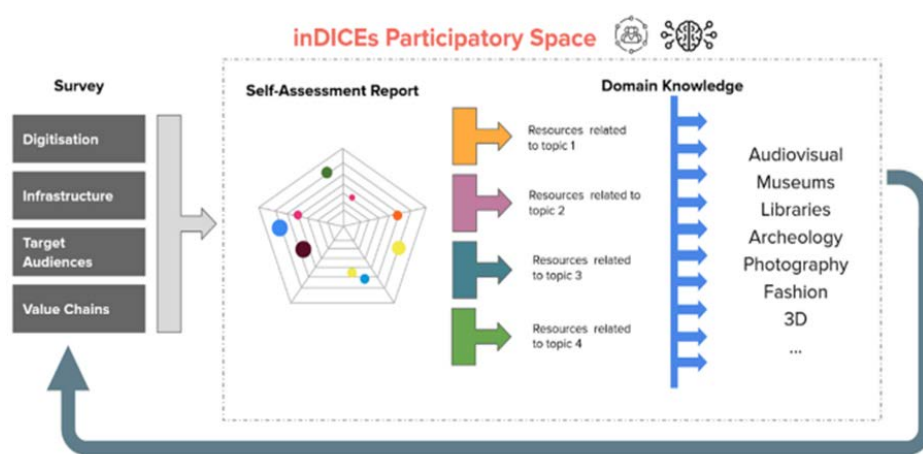


Figure 2.13: The CHI Self-assessment tool concept proposed by Bocyte, Oomen, &Truyen (2021).

Another measurement framework (Figure 2.14) is developed, and it has been used to evaluate the digital readiness of Italian museums (Agostino & Costantini, 2022).

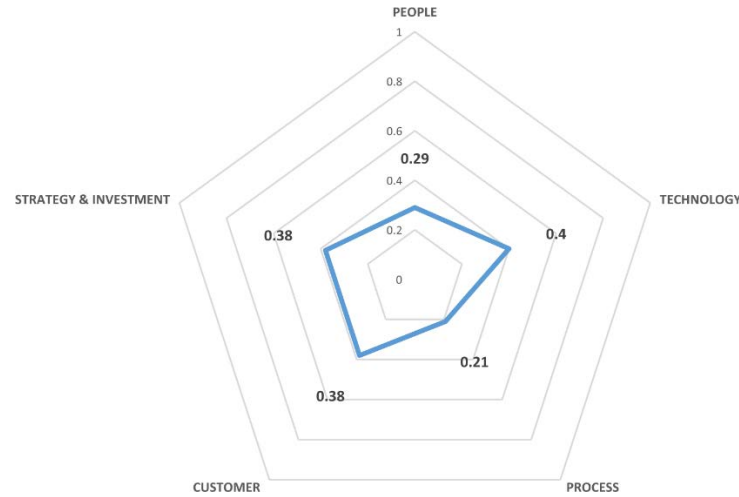


Figure 2.14: The digital transformation measurement framework proposed by Agostino and Co-researcher(2021).

In addition, the theoretical digital business model framework developed by Russo-Spena et al. (2022) acts as enhancements instead of replacing traditional business models (Figure 2.15).

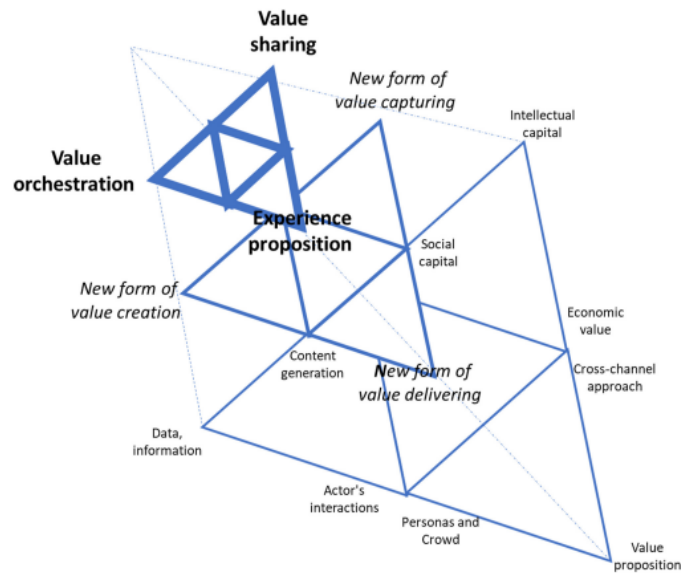


Figure 2.15: The digital business model by Russo-Spena et al. (2022)

On the other hand, some researchers proposed articles related to digital transformations but focused on the digital technologies the museum adopts as well as the

management of the museum. Guarino and co-researchers (2020) focus on the types of digital facilities and services adopted by Italian and Campania GLAMs. They suggest that a specific digital maturity model for GLAM organizations is needed. In addition, two articles use the same evaluation form to learn about the digital technologies used in all three phases (pre-visit stage, visiting stage, and post-visiting stage) in museums in the country they focus on. De Bernardi and co-researchers (2018) focus on museums in Torino, while Parsehyan (2020) focus on the museums in Turkey's evaluation results. The evaluation result allows them to identify which museums are Sleepers, Experience-Oriented, Visit-Oriented, and Social-Oriented. Moreover, another article shared an example of a museum in Barcelona undergoing digital transformation (Karayilanoğlu, 2019). The findings allow researchers to see the outcome of digital transformation, where digital facilities and mobile applications with AR systems are adopted to promote and alter real-time museum experiences.

Based on the digital transformation frameworks for museums discussed above, each has its aim and highlighted dimensions. Some articles addressed the dimensions of digital transformation in museums based on their proposed framework, as shown in Table 2.7 below. Traboulsi and co-researchers (2017) focus on active senior visitors' perceived value and satisfaction. In contrast, the other nine articles focus on the organizations to picture the whole thing.

Table 2.7: The dimensions of the proposed Digital transformation Framework.

Author(s)	Core Dimensions of Digital transformation museums
Traboulsi et al. (2017)	• Epistemic value (Perceived value concept) • Functional value (Perceived value concept)

Table 2.7 continued

	• Economic value (Perceived value concept) • Hedonic value (Perceived value concept) • Social value (Perceived value concept) • Overall satisfaction (satisfaction concept) • Recommend (satisfaction concept) • Intention to repeat the experience (satisfaction concept)
Hook & Kharitonova (2017)	• Customer experience • Business process • Business models
Pereira (2017)	• Culture • Technology • Organisation • Insights
Damala et al. (2019)	• Design • Content • Operation • compliance
De Bernardi et al. (2019)	• Unstructured Approach • Partial Approach • Integrated Approach
Balzano (2019)	• Digital Strategy

Table 2.7 continued

	• Digital Culture and Leadership • Data Analytics • Digital Skills/Competences • Human Resources Involved • Financing • Partnerships/Collaborations
Kamariotou et al. (2021)	• Technology • Organisation • Audience-centered approach • Communication
Cosmin & George (2021)	• Social Media • Augmented Reality • Virtual Reality • AI powered chatbot
Agostino, D., & Costantini, C. (2021).	• People • Technology • Process • Customer • Strategy and Investment
Russo-Spena, Tregua, D'Auria, & Bifulco. (2022).	• Value orchestration • Experience propositions • Value sharing

The author has divided these frameworks into 4 types of digital transformation framework (DTF), which are framework that focus on digital transformation more towards business (Hook & Kharitonova, 2017; Russo-Spena et al., 2022), framework that focus on the digital technologies that are adopted by the museums (Damala et al., 2019; Cosmin & George, 2021), framework that acts as a guideline when planning a digital strategies or museum projects (Traboulsi et al., 2017; De Bernardi et al., 2019; Balzano, 2019; Kamariotou et al., 2021), and framework that focus on evaluating the digital readiness or maturity of museum to undergo digital transformation (Pereira, 2017; Bocyte et al., 2021; Agostino & Costantini, 2022). As the aim of this study is to acquire the digital readiness of museum in Malaysia to achieve digital transformation, the author decides to adopt the digital transformation framework proposed by Agostino & Costantini (2022) as the main reference of this research as it highlights the five dimensions of digital transformation, which is people, technology, process, customers, along with strategies and investments. With these five dimensions, the author can acquire the current digital readiness of the museums in terms of the museum management perspective.

2.5 Digital Readiness of Museums

Digital is defined as a digital device and its application, while readiness is a developmental phase that describes the desire, willingness, and ability to act (Nasution et al., 2018). In addition, the term “Digital Readiness” is defined as a proclivity and willingness to switch to and adopt digital technology, as well as a willingness to create new innovative opportunities using this technology to help an individual, organization, industry, or country achieve their goals faster and with greater success (Nasution et al., 2018). Based on Nasution and co-researchers (2018), the term refers to the individual levels of digital readiness and the attitude towards digital technology, along with the attitude towards the interaction with

digital technology, which are the two basic components of this term. Their findings focus more on technology readiness. Aside from that, Soomro et al. (2020) state that a digital readiness model is required to lead the digital transformation path and continuously self-evaluate themselves. It can help managers understand the significance of digital technologies. Their findings show that there are five main study concepts based on the digital readiness models they explored where the main focus is digital technologies adopted and readiness of the organisation in accepting the adoption of digital technologies (Table 2.8).

Table 2.8: The five main study concepts

The types of study concepts	The definition
Information Technology (IT)	It is the usage of hardware and software for information transmission and/or retrieval and for practical purposes
Technological, Organizational and Environmental Framework (TOE)	It focuses on implementing innovations, from identifying needs to implementation.
Operational Technology (OT)	It is the usage of hardware and software to keep an eye on and/or change physical systems as well as to accomplish business objectives.
Industrial Internet of Things (IIOT)	It mainly focuses on transforming conventional factories into factories of the future.

Table 2.8 continued

Unified Theory of Acceptance and Use of Technology (UTAUT).	It is about a user's intended use of an information system and his or her actual use.
---	---

In addition, they analysed the dimensions highlighted in the 22 digital readiness model. They divided them into four themes: Digital Systems and Infrastructure, Digital Tools and Applications, Digital Eco-system and Culture, and Digital Agents and Skills. It showed that the digital readiness models focus on the technology and the user's readiness in the company or an organization. Nguyen et al. (2019) defined digital readiness as “the degree to which an organization is ready to transform the current organization digitally. This degree reflected on its digital assets, capabilities to identify opportunities and coordinate these assets and the commitment of all members to digital transformation.”

They focus on technology readiness and combine the elements of organization readiness. Some articles, like Halpern et al. (2021), showed that organizational readiness directly affects the digital changes at airports, which makes it possible to define the several stages that eventually lead to digital transformation. However, Nguyen et al. (2019) argued that organization readiness has limitations, where the solid theoretical grounding of organization readiness is lacking, as well as the overemphasis of a firm's assets in determining the readiness. They also state that the researcher, Weiner, contends that collective efficacy captures how employees perceive the firm's assets and flexibility. While this method appears appropriate when readiness is assessed at the individual (employee) level (and aggregated to the firm level), perceived efficacy is ineffective when firm-level readiness is directly evaluated because it cannot account for the complexity of organisational

assets and capabilities. Therefore, they have proposed a conceptualization of digital readiness for industries (Figure 2.16). Due to the pervasiveness of digital transformation, the findings of Nguyen et al. (2019) make management contributions by offering suggestions about the elements of digital readiness and the process by which businesses can improve their level of digital readiness.

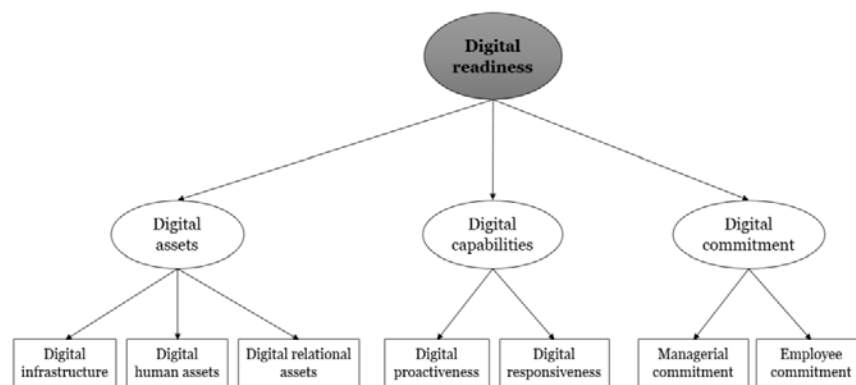


Figure 2.16: The conceptualization of digital readiness.

As the articles mentioned above, digital readiness is implemented to determine a company or industry's level of digital readiness using the technologies adopted. Digital readiness has expanded from focusing on the readiness of the technologies to measuring the readiness of the technologies and the organization's readiness in adapting the digital technologies, making it possible for the organization to lead the path for digital transformation. The dimensions mention in the digital readiness proposed by Nguyen et al. (2019) is quite similar to the dimension of the main reference of this study, where the 'digital assets' dimension is related to 'customers' and 'technology' dimension, 'digital capabilities' dimension is relate to 'people' and 'process' dimension, as well as 'digital commitment' relate to 'strategy and investment' dimension. As museums nowadays have adopted digital technologies to enhance the visitors' experiences, the digital readiness of the museum should be acquired to

enable the museum management to know the readiness of the museum to undergo digital transformation. Tim et al. (2020) advise future researchers to investigate the characteristics that permit or restrict the use of new technologies in pre-digital institutions and how the affordances of these technologies might be achieved to facilitate the change. As digital transformation occurs after the digitisation and digitalisation of the company, it can act as an assessment to review the how prepared the digitisation and digitalisation of the company, which is known as the digital maturity or readiness assessment. Based on the search on SCOPUS, the number of articles found based on the term “Digital Readiness” AND “Museum” is only two (Figure 2.17), where both articles focus on Italian museums. Based on SCOPUS (Figure 2.18) and Web of Science (Figure 2.19), both online databases showed the same results, which are the article written by Agostino and Costantini (2022) and another written by De Bernardi et al. (2019).

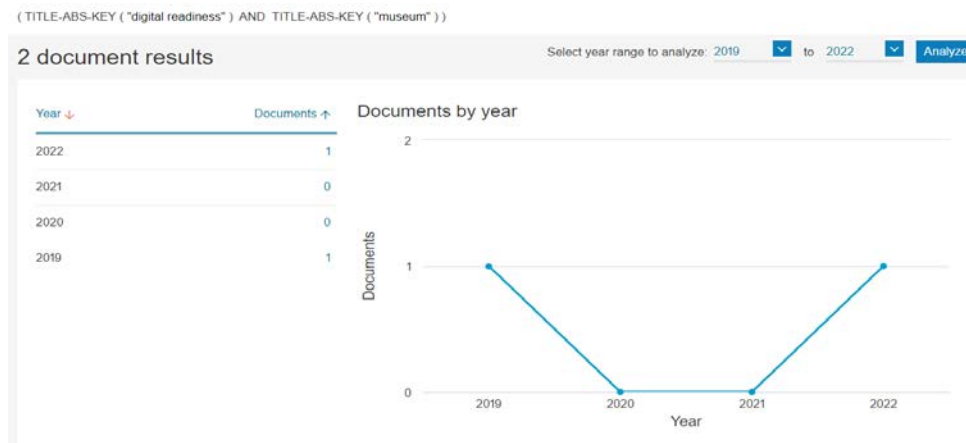


Figure 2.17: The document results of the terms “Digital Readiness” and “Museum”.

2 document results

(TITLE-ABS-KEY ("digital readiness") AND TITLE-ABS-KEY ("museum"))

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Figure 2.18: The articles were found using the key terms “Digital Readiness” and “Museum” in SCOPUS.

2 results from Web of Science Core Collection for:

Q "digital readiness" (All Fields) and "museum" (All Fields)

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1 A measurement framework for assessing the digital transformation of cultural institutions: the Italian case 3 Citations

Agostino, D and Costantini, C

Jul 14 2022 | Nov 2021 (Early Access) | [MEDITARI ACCOUNTANCY RESEARCH](#) 30 (4), pp.1141-1168

Enriched Cited References

Purpose Public and private sector organisations are widely endorsing digital transformation processes, but little is known about the level of digitalisation of an organisation as a whole. The purpose of this paper is to develop a framework to assess an organisation's level of digital transformation as a whole, taking the field of museums as an exemplary case of application. Design/methodology/a ... Show more

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De Bernardi, P, Bertello, A and Shams, SMR

2019 | [TOURISM ANALYSIS](#) 24 (3), pp.315-327

Museums play an important role in tourist flows, especially in cities that are famous for their cultural heritage. To valorize their role, these cultural institutions should open themselves to visitors as vectors of social, educational, and entertainment values. In particular, museums need to reinvent how they transmit information about their collections and how they engage visitors, keeping in ... Show more

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Figure 2.19: The articles were found using the key terms “Digital Readiness” and “Museum” in Web of Science.

Both articles are mentioned in chapter 2.4, as they focus on the digital readiness of Italian Museums in term of digital transformation. Agostino & Costantini (2022) analyses the organizational digital readiness in Italian museums to achieve digital transformation

while the other study (De Bernardi et al., 2019) focus on the strategies museums plan to achieve digital transformation. There are digitization initiative of Malaysian museums been highlighted by few articles (Abd Manaf, 2007;Salleh & Bushroa, 2022;Fauzi et al., 2022), however there are yet to have articles that study the digital readiness of Malaysian museums. The majority of the museums have their own policies to register their digitisation project, which are selection policy, access policy, content management policy, intellectual policy and preservation policy (Abd Manaf, 2007). As for Salleh & Bushroa (2022), they share the initiatives of Malaysian government done to protect cultural heritage assets by introducing Malaysian architectural history, Malaysian Urban-Rural National indicators Network for Sustainable Development and National Heritage Act 2005. They also share that government agencies, nongovernmental organizations (NGOs), institutes and universities in Malaysia have made effort to conduct digitisation in museums but there are still challenges that slow down the digitisation process. Suggested by Fauzi et al. (2022), there is a need to conduct digital readiness to the Malaysian museums to learn about the current state of the museums. According to Agostino & Costantini (2022), a measurement framework is proposed to evaluate the organization's digital readiness of the museums. As the questionnaires are provided, the researcher questions whether the questionnaires are suitable to be adopted to acquire the digital readiness of the Malaysian museums. This is due to the management of Italian museums and Malaysian museums is not the same. Each countries have their own management approach in museums. In addition, the digital transformation journey proposed by Aras & Büyüközkan (2023) depicts that the journey required 4 stages, which are awareness, readiness, planning and executions. They shared that the readiness stage consists of the digital maturity model and assessment before planning the digital transformation roadmap of the organization. Aside from that, their findings show the list of digital maturity

models of adopted by firms used the terms “Digital Readiness” in terms of “Digital Maturity” and the dimension of the digital maturity which is similar the main reference of this study. The digital maturity and digital readiness model help researchers or the organisation to acknowledge the performance of a company in endorsing digital transformation. In this case, the research on digital readiness of museums and its outcome (the digital readiness index of museums) will benefit the museum management as a guide to know the readiness of the museums to move towards digital transformation and the types of digital technologies to adopt depending on the strategy and investment of the museum.

2.6 Chapter Summary

In this chapter, the highlighted terms are further discussed, and the gaps in the literature are found. The increase in digitization and digitalisation articles in this digital era and COVID-19 is a significant catalyst to accelerate the number of published digital transformation articles for different fields. As mentioned in this chapter, there are problems faced by museums in Malaysia during digitization and digitalisation. The readiness of a museums to achieve digital transformation can be assess by the digital maturity or digital readiness assessment. From the assessment, the result enables researchers or museum managements to acknowledge which dimension should put more effort to achieve digital transformation. Based on the author’s findings, the articles on the digital readiness of museums were mainly published to study the case of museums from Italy. Some local articles explore the digitization of museum collections through survey (Abd Manaf, 2007) and literature review (Salleh & Bushroa, 2022; Fauzi et al., 2022), but there are yet to be articles on the digital readiness of Malaysian museums. According to Fauzi et al. (2022), growing technologies should be used wisely to benefit the museum sector and other future industries' continuity and relevance. As a result, they suggest that an in-depth study be

conducted to assess the digital readiness of Malaysian museums. Aside from that, the management of Malaysian museums may differ from Italian museums, which leads the author questions the suitability of the measurement framework proposed by Agostino and Costantini for evaluating the digital readiness of local museums. Thus, researchers decided to validate the digital readiness questionnaire proposed by the Italian researchers before using the questionnaire to study the digital readiness of Malaysian museums in this digital era.

CHAPTER 3

METHODOLOGY

3.1 Overview

In this chapter, the methodology of the research is explained in detail. The research design, population, sample and sampling procedure, instruments tools, research procedure, and study ethics were explained in this chapter.

3.2 Research Designs

Referring to research problems mentioned in Chapter 1.2, the researcher aims to determine the digital readiness index (DRI) of Malaysian museums to acquire the current readiness of museum in achieving digital transformation. The five dimensions of the digital Transformation (People, Technology, Process, Customer and Strategy and investment) serve as a guideline for researcher to acknowledge digital readiness of museums in terms where all these five dimensions needed before venturing into the dimension that needs more effort in. So, there are two phases in this study where this research is design to validate the suitability of the adopted Digital Readiness Questionnaire (DRQ) and later used the validated DRQ to determine the DRI of Malaysian museums.

The research design of the first phase are qualitative and quantitative research design method. This is because the method to conduct content validation of the questionnaire can be as face-to-face or non-face-to-face. There are a total of three content validations conducted, where the first validation (CV I) conducted face-to-face (mixed design method) while the second (CV II) and third validation (CV III) is conducted non-face-to-face (quantitative design method). The CV I consist of quantitative data where the validation

score of the questions of DRQ is collected and for qualitative data where the interview was conducted to discuss the questions that need to be localised for the questionnaires. As for CVII and CVIII, the data collected is quantitative as the collection of data is collected non-face-to-face.

For the second phase, the research design is quantitative. The researcher used the localised DRQ (outcome of the first phase) to collect the participants' feedback about the digital readiness of the museum(s) they manage.

3.3 Population, Sample, and Sampling Procedure

Ahmad et al. (2023) highlighted the importance of understanding population and sample in research to find valid conclusions. Population represents the whole group of individuals, objects or events that share the same characteristic which is focus in the study to draw the conclusion of the study (Jilcha Sileyew, 2019). In this study, the population in the first phase of the study is museum experts from Malaysian museums while the second phase of the study is the number of museums in Malaysia. There are a total of 209 museums in Malaysia (Kaur, 2022), however there are no specific record on the number of museum managers in Malaysia.

Studying the whole population of museum experts and museum managers in Malaysia for validating the adopted DRQ to adapt the questionnaire for museums in Malaysia is impractical and time consuming. So, the author scale down to a small group, a sample to collect and analyse data that provide insights of the digital readiness of Malaysian museums. According to Bhardwaj (2019), research sample is known as a smaller and manageable group used by researchers to make inferences and conclude the research outcomes about the entire population. Thus, the sample of museum experts is 2 which is

from Sarawak Museum Department in the first phase, while the author targeted to collect a total of 100 museums as a sample to answer the DRQ in the second phase.

The sampling procedure in both phases in this study is purposive sampling. Purposive sampling is commonly use in research studies, aid in ensuring sample of the research is not bias which increase the reliability of the findings (Nyimbili & Nyimbili, 2024). As there are different types of purposive sampling, the author has selected intensity sampling, where this sampling is mixed and relevant to the topic of this research and include participants that are part of the selected population (Nyimbili & Nyimbili, 2024).

So, in the first phase, the author prepared official faculty letter (for permission to conduct research) along with the adopted DRQ and then email to the Sarawak Museum department for appointing their museum experts to validate the suitability of the questionnaire for measuring the digital readiness of museums in Malaysia. As the museum experts appointed by Sarawak Museum department is 2, the author decided to carry on with the validation as the minimum number of evaluators to validate questionnaire is two (Yusoff, 2019). So, the sample of the first phase is 2 museum experts.

As for the second phase, the sample of museums selected depends on the number of museums that managed to answer the adapted DRQ within the duration of DRQ data collection, which is 100 museums. Like phase 1, the author emailed the official faculty letter (for permission to conduct research) and the adapted DRQ (outcome of phase 1) to all the museums listed by Kaur (2022) and requested the museum departments to appoint their museum manager or person in-charge of digital transformation to answer the DRQ. In the data collection duration in Phase 2, there are a total 100 museums that answered the adapted DRQ, however only 40 museums manager have responded to the researchers because there are 7 museum managers that manages more than one museum.

3.4 Instruments and Tools

The instruments and tools that the researchers use to conduct the research are digital readiness questionnaires, content validity, interviews, and case study of museums in Malaysia by conducting online survey. The online survey consists of the consent form, demographic form, and digital readiness questionnaire.

3.4.1 Digital Readiness questionnaires

The digital readiness questionnaires (DRQ) that are adopted from Agostino and co-researchers (2022) are used for determining the digital readiness of museums in Malaysia in achieving digital transformation. The questionnaire consists of five dimensions (w_i), which is people, technology, process, customer, along with strategy and investment. People dimension stands for the existence of the related digital skills and the staff capabilities. The technology dimension stands for the digital technologies used, data analysis practices along with the existence of connectivity (Wi-Fi) available to museum visitors. The process dimension depicts the scope in digitised internal processes. As for customer dimension, it indicates the ability of museums to engage with their visitor by using digital interaction channels before and after the purchase happens, in this case the purchase of museum ticket. The last dimension, 'Strategy, and Investment', referred to measure the ability of organisation (museum) to aim for a long-term digital strategy while investing its resources in projects relate to digital transformation.

The values beside each of the dimension in Appendix A is the weight of dimension i which will be insert into the digital readiness index formula when calculating the digital readiness index (DRI) of a museum. Under the dimensions, there are a few sub-dimensions (w_j), metrics (w_k), and the question (Q_k). The values beside the items in w_j , w_k , and Q_k

shown in Table 3.1 are the assigned values by the Italian researchers (Agostino & Costantini, 2022). The researcher adopts the method of analysing the DRI as well as the assigned formulas from the Italian research.

In addition, there are questions in DRQ consists of Likert-scale questions, Boolean questions, multiple choice questions, Multiple-Choice questions, and Grid questions. The score of each answer of the Likert-scale questions is assigned ranging from 0 to Nmax (maximum value assigned) then normalised them in a 0-1 scale using the maximum value as a proxy. Boolean questions will be evaluated with 0 or 1. As for multiple-choice questions, one or more options can be selected, so the formula to calculate the score for multiple choice questions is followed where:

- Qk = score of question k
- q = number of available options belonging to question k
- bh = number of options selected

$$Qk = \frac{bh}{q}$$

For the grid questions, the respondent needs to answer 2 or more question at the same time.

The researcher uses the formula to evaluate the score of the question (Qk) where:

- $Noptions$ = number of available options belonging to question k
- sl = score of option l

$$Qk = \sum_{l=1}^{Noptions} sl * \frac{1}{Noptions}$$

After the Q_k scores of digital readiness questionnaire are calculated, the scores are calculated to find the digital readiness index (DRI) of a museum using the DRI formula. The DRI of the museums is calculated using the formula below where:

- w_i = weight of dimension i
- w_j = weight of sub-dimension j
- w_k = weight of question k
- Q_k = score of question k.

$$DRI = \sum_{i=1}^5 w_i * \left(\sum_{j=1}^n w_j * \left(\sum_{k=1}^m w_k * Q_k \right) \right)$$

The Appendix A depicts the original questions (Q_k) along with the dimensions (w_i), sub-dimensions (w_j), and metrics (w_k) of the adopted digital readiness questionnaire. The adopted DRQ was validated and localised for the second phase of the research study.

As for the localised DRQ (Appendix B), it is used in the second phase to determine the digital readiness of Malaysian museums in archiving digital transformation. The formula of the DRI of the adapted DRQ is the same as the adopted DRQ. However, only the calculation of the Q_k of adapted DRQ is slightly different from the Q_k of the adopted DRQ. Based on Appendix B, Questions 5 and 10 are open-ended and are not assigned a score, while Questions 1- 4, 6-9, 11-18, and 19 are closed-ended with options assigned scores. The score of Q1 and Q2 is converted based on the selected option. For multiple-choice questions (Q3, Q11, Q12, Q14-Q16, and Q18), the formula applied to calculate the score (Q_k) is the sum of the selected options, while the choice scores of Q4 and Q13 were calculated using the score of the question multiply with the score of selected options.

3.4.2 Content Validity

The content validity (CV) proposed by Yusoff (2019) was adopted in this research to validate the suitability of the questionnaire to measure the digital readiness of Malaysian museums in term of digital transformation. It is important to make sure the validity of the questionnaire before using the questionnaire for the second phase. The content validity used in this research act as important evidence to support the validity of the questionnaire (measuring tool) for the research (Yusoff, 2019). The adopted DRQ contains five dimensions, 9 sub-dimensions and 19 questions. The researcher needed experts' judgement on the degree of relevance of each question to measure the sub-dimensions of Digital Readiness of museums to achieve digital transformation. There are a total of 5 steps in content validity. Step 1, the author prepared the CV form, which is converting the questionnaire (Appendix C) into Microsoft form (<https://forms.office.com/r/UjH72y0nVL>) then step 2, is to select the panel of experts (the 2 museum experts appointed by the Sarawak museum department). Their reviews should be based on the definition and relevant terminologies that are provided to them. Step 3 is conducting content validation. They should be as objective and constructive as possible in their review and use the following rating scale, where:

Degree of Relevance:

- 1 = the question is not relevant to the measured dimension
- 2 = the question is somewhat relevant to the measure dimension
- 3 = the question is quite relevant to the measured dimension
- 4 = the question is highly relevant to the measured dimension

The first or second degree of relevance selected will be converted into 0 value (question is not agreed) while third and fourth degree of relevance selected will be converted to the value of 1 meaning the questions is agreed. The converted data was collected for further calculation of the content validity index (CVI) indices. The CVI indices that are calculated by the researcher are item-level content validity index (I-CVI), scale-level content validity index based on the average method (S-CVI/Ave) and scale-level content validity index based on the universal agreement method (S-CVI/UA). The formula of I-CVI is the agreed item divide by the number of experts. The S-CVI/Ave have 2 calculation, which one is the sum of I-CVI score divide by the number of items while another is the sum of proportion relevance rating divided by the number of experts. The S-CVI/UA is the sum of universal agreement scores divided by the number of items.

The accepted CVI value, which is 0.8. Step 4, the author conducts an online meeting to discuss with the museum experts in reviewing the domain and items of adopted DRQ. The last step is providing the score on each item (the DRQ questions). These last 2 step can be conducted face-to-face or non-face-to-face. In this case, the first CV of the last 2 step was conducted face-to-face where an online interview (Chapter 3.4.3) was conducted. The CV approach was conducted twice more (non-face-to-face) after the interview in CV I before finalized the DRQ (Localised DRQ).

3.4.3 Interview

The interview was conducted in the first CV of the first phase of this study. In the interview, the museums experts are asked to define the meaning of the digital readiness of museum based on their knowledge and to validate the questionnaires (mentioned in Chapter 3.4.1) that are adopt from the Italian researchers (Agostino & Costantini, 2022). The interview was

carried out using Zoom online meeting. Thus, the questions asked in the interview are shown below.

1. What is the meaning of digital readiness based on your understanding?
2. Based on the questionnaires, is it suitable for determining the digital readiness of the museums in the organizational level?

3.4.4 Case study

The case study consists of an online survey that includes the consent form, six demographic information questions, and the adapted DRQ. The online survey was distributed to all the museums the researchers found using Microsoft form (<https://forms.office.com/r/LYDsf531dD>).

The demographic information questions enable researchers to get to know about the participants, museums the participants managed and keep track of the participants of the survey that responded to the museum they managed. Only the fifth question is a closed one while the rest are open questions. Below are the questions asked in the demographic section:

1. Name
2. Gender
3. Occupation
4. Please provide the name of the museum where you are currently employed.
5. How long have you worked in the museum?
6. What is the annual average number of visitors visiting your institution?

The next section is the finalized DRQ that was localized by the researcher and the museum experts from phase 1. The DRQ consists of 19 questions. The questions of the DRQ can be referred to in Appendix D.

3.5 Research Procedure

This study consists of two phases (Figure 3.1). The first phase is to validate a digital readiness questionnaire for measuring the digital readiness of Malaysian museums in terms of digital transformation, which answers the first research question of this study. The second phase is to answer the second research question, where the researcher determines the DRI of Malaysian museums by using the adapted DRQ.

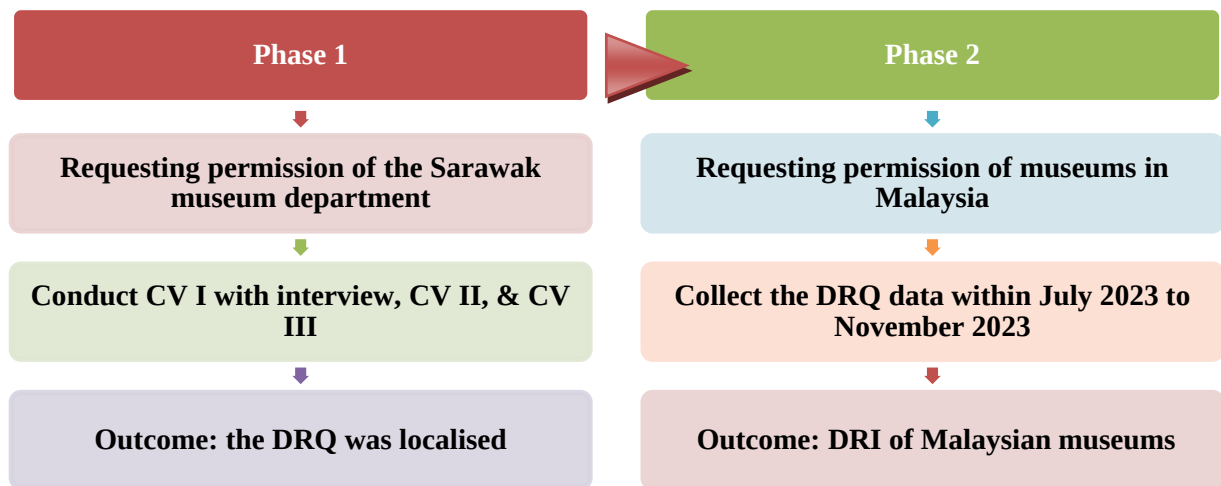


Figure 3.1: The flow of the research procedure.

In the first phase, the researcher emails the Sarawak Museum department for requesting them to appoint museum experts to validate the adopted DRQ. The questionnaire prepared for content validation was validated by the museum experts. After that, the result of the first content validation (content validity index) was calculated in terms of I-CVI, S-CVI/Ave along with S-CVI/UA and it was shown to the museum experts during the interview via Zoom. The questionnaire was modified based on the interview and then distributed to the museum experts to validate the Content Validity Index (CVI) of the modified digital readiness questionnaire (DRQ) for the second content validation (CV II). The result will determine whether the researcher will conduct another CV (CV III) of the revised questionnaire (second time) before finalizing the DRQ questions. In this case, the

third content validation (CV III) was conducted as the CVI indices did not pass the benchmark (0.8). After the CVIII, the DRQ was adapted and finalised for the second phase of the study.

In the second phase, the researcher conducted a case study by using the finalized DRQ to evaluate the DRI of the museums in Malaysia. A Microsoft form is designed and added the consent form, demographic form as well as the finalized DRQ, then the links and official faculty letter was distributed to all museum departments in Malaysia via email and they have assigned their museum management or staff. The research author selected Microsoft Forms as the data collected can be exported to Excel, allowing researchers to analyse the data in Excel. Like the research method conducted by Agostino and co-finding researchers (2022), the researcher will use Microsoft Form and Microsoft Excel software to collect data and further analysed the score of the Digital Readiness Index (DRI) of museums in Malaysia. These softwares allows the researcher to analyse the data and develop the radar chart of the DRI score of each museum. A radar chart is a graph that allows researcher to plot multiple variables, in this case is five dimensions of the DRQ, allowing researcher easily to identify which dimension need to be improved. Both phases of data are collected and further analysed and discussed in this research's discussion section. The data collected will let museum managers know which dimension to focus on based on the DRI Score.

3.6 Chapter Summary

In conclusion, the researcher explains the process of conducting the research and the instruments and tools needed before carrying out the research. The process is divided into two phases to answer the research questions of this study, which is to validate the suitability of the DRQ for Malaysian and used the adapted DRQ to acquire the digital readiness of

Malaysian museums. The findings and the results were collected, described, and discussed in the next chapter.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Overview

Chapter 4 depicts the collection of data in phase 1 and phase 2. The collected data from both phases were calculated and analysed. The researcher explains the collection and analysis of data in both phases separately.

4.2 Collection and Analysis of Data in Phase 1

The primary data collected in this phase is from the first, second and third content validation as well as the interview response in the first content validation. The author explains the collected data in this phase in terms of first content validation with the interview (CV I), second content validation (CV II) and third content validation (CV III). The analysis of the collected data in phase 1 and the outcome of the validation are explained in another subsection (Chapter 4.2.2).

4.2.1 Content Validation Data

4.2.1.1 First Content Validation (CV I)

In the first content validation (CV I), the data collected from the Microsoft form is degree relevance scores of adopted DRQ questions given by the museum experts (MEs) shown in Table 4.1. Based on the table, the given degree of relevance scores is converted to 0 or 1. The degree relevance score given by ME, 1 or 2 was convert to 0 which means the question is not relevant to the measured dimension and 3 or 4 was converted to 1 which means the question is relevant to the measured dimension. Referring to Table 4.1, only three questions (Q6, Q9 and Q10) have both ME agreed the validity to measure dimensions. The

questions, Q1-Q5, Q7-Q8, Q11-Q16 and Q18-Q19 were agreed by one ME, which means these questions is not valid to measure dimension. Q17 was not agreed by both MEs.

Table 4.1: CV I data

DRQ questions	Degree Relevance Scores		Converted Score	
	ME1	ME 2	ME 1	ME 2
Q1	3	1	1	0
Q2	3	1	1	0
Q3	4	2	1	0
Q4	3	1	1	0
Q5	4	2	1	0
Q6	4	3	1	1
Q7	4	2	1	0
Q8	4	2	1	0
Q9	4	3	1	1
Q10	4	4	1	1
Q11	4	2	1	0
Q12	4	2	1	0
Q13	4	2	1	0
Q14	4	2	1	0
Q15	4	2	1	0
Q16	4	1	1	0
Q17	1	1	0	0

Table 4.1 continued

Q18	4	2	1	0
Q19	3	1	1	0

The questions that are not agreed were highlighted in the interview with both MEs from the Sarawak Museum Department through Zoom meeting at the same time. The first question, “What is the meaning of digital readiness based on your understanding?” was asked in the interview. The first museum expert stated, “For my understanding, digital readiness is also defined as the level of readiness to change your manual work process into using digital software or anyways to carry on your daily routine.”. The other museum expert stated, “Same like what [museum expert 1] say...Basically converting our manual process...our manual work from manual to the digital ones... to the computer things.” Both researchers have similar perspectives on defining digital readiness. As for the second question, the researchers and the MEs discussed the suitability of the questions in the DRQ questionnaire as well as the answer options. After the discussion with the MEs, the questionnaire was edited and forwarded to MEs for the second content validation to validate the validity of the edited questionnaire. Table 4.2 depicts the difference between the adopted questionnaire and the edited questions after the Zoom Meetings. The modified questions in Table 4.2 are not finalized version.

Table 4.2: The modification of the questionnaire.

Adopted questions	Modified after online discussions
In your institution, are there employees specialized in digital transformation?	Does your institution have employees who specialize in information technology (IT)?

Table 4.2 continued

In your institution, is it present any of these positions?	Does your institution have any of these positions?
Which one of these technologies is present in your museum?	Which of these technologies are present in your museum?
Is there a digitalized version of the museums' artefacts?	Is there a digitalized version of the museums' artefacts?
To what extent is your collection catalogued?	To what extent is your collection catalogued?
Do you gather data about visitors?	Do you gather data about visitors?
Do you monitor data about your social network channels?	Do you monitor data about your social network channels?
Do you monitor data of online reviews?	Do you monitor data of online reviews?
Does your institution have a wi-fi connection?	Does your institution have a Wi-Fi connection?
Does your institution have a ticketing service?	Does your institution have a ticketing service?
Which kind of ticketing service is present in your institution?	Which kind of ticketing service is present in your institution?
How do you control visitors' access?	How do you control visitors' access?
Do you have an informatic system that supports these activities?	Do you have an informatic system that supports these activities?
Which one of these marketing activities do	Which one of these marketing activities do

Table 4.2 continued

you perform (internally or externally)?	you perform (internally or externally)?
Which social accounts do you have?	Which social accounts do you have?
On which of these review websites are you subscribed?	Which of these review websites are you subscribed to in order to increase the number of visitors?
Is there a strategic plan for digital innovation?	Are there any ideas or efforts in your museum to adapt to digital transformation?
In which digital activities did you invest in the last 2 years?	In which digital activities did you invest in the last 2 years?
Which is the percentage of investment you committed to digital innovation?	Which is the estimated percentage of investment you committed to digital innovation?

4.2.1.2 Second Content validation (CV II)

As for CV II, the modified questions (Table 4.2) were validated. The collected data and the converted data are shown in Table 4.3. Based on the table, it showed that six questions (Q2, Q4, 10, Q11, Q16 and Q19) were not agreed to by one of the museum experts. The validity of these questions was discussed with the MEs via email (non-face-to-face) and the structure of the questions were modified (Table 4.4).

Table 4.3: CV II data

DRQ questions	Degree Relevance Scores		Converted Score	
	ME1	ME 2	ME 1	ME 2

Table 4.3 continued

Q1	4	3	1	1
Q2	4	2	1	0
Q3	4	4	1	1
Q4	4	2	1	0
Q5	4	3	1	1
Q6	4	3	1	1
Q7	4	3	1	1
Q8	4	3	1	1
Q9	4	3	1	1
Q10	4	2	1	0
Q11	4	2	1	0
Q12	4	3	1	1
Q13	4	3	1	1
Q14	4	3	1	1
Q15	4	3	1	1
Q16	4	2	1	0
Q17	4	3	1	1
Q18	4	3	1	1
Q19	4	2	1	0

Table 4.4: The modified questions in the CV II

Bil.	Modified questions in CV II
1	Does your institution have employees who specialize in information technology (IT)?
2	Do any of these positions are present at your institution?
3	Which of these technologies are present in your museum?
4	What is the estimated percentage of museum artefacts in your institution that have a digitalized version?
5	To what extent is your collection catalogued?
6	Do you gather data about visitors?
7	Do you monitor data about your museum's social network channels?
8	Do you monitor data of online reviews?
9	Does your institution have a Wi-Fi connection?
10	Is there a ticketing service at your institution?
11	What kind of ticketing service does your institution provide?
12	How do you control visitors' access?
13	Do you have an informatic system that supports these activities?
14	Which one of these marketing activities do you perform (internally or externally)?
15	Which social accounts did your museum use?
16	Is your museum listed on any of these review websites?
17	Are there any ideas or efforts in your museum to adapt digital transformation?
18	In which digital activities did your museum invest in the last 2 years?
19	What is the estimated percentage of your museum's investment in digital innovation?

4.2.1.3 Third Content Validation (CV III)

In CV III, the modified questions in CV II were validated and degree of relevance score of the questions given by the MEs was collected. Table 4.5 showed the given degree of relevance score of the questions and the converted scores of the questions. Like CV II, the modified questions that are not agreed by both museum experts were discussed via email. The questions are finalised in this validation (Table 4.6).

Table 4.5: CV III Data

DRQ questions	Degree Relevance Scores		Converted Score	
	ME1	ME 2	ME 1	ME 2
Q1	4	4	1	1
Q2	4	3	1	1
Q3	4	4	1	1
Q4	4	2	1	0
Q5	4	3	1	1
Q6	4	4	1	1
Q7	4	4	1	1
Q8	4	4	1	1
Q9	4	4	1	1
Q10	4	4	1	1
Q11	4	3	1	1
Q12	4	3	1	1
Q13	4	4	1	1
Q14	4	3	1	1

Table 4.5 continued

Q15	4	3	1	1
Q16	4	3	1	1
Q17	4	2	1	0
Q18	4	3	1	1
Q19	4	3	1	0

Table 4.6: The finalised DRQ questions

Bil.	Modified questions in CV II
1	Does your institution have employees who specialize in information technology (IT)?
2	Do any of these positions are present at your institution?
3	Which of these technologies are present in your museum? (More than one answer is possible)
4	*the question is removed as it does not meet the minimum score of the questions.
5	To what extent is your collection catalogued? (*Only ans next questions if your museum has adopted Other Software to handle the catalogue) > >(Next Question) List out the available software used by your museum if your museum handled the Cataloguing through other software.
6	Do you gather data about visitors?
7	Do you monitor data about your museum's social network channels?
8	Do you monitor data of online reviews?
9	Does your institution have a Wi-Fi connection?
10	Is there a ticketing service at your institution? (*Only answer No.17 and No.18 if you

Table 4.6 continued

	select "Yes" for this question)
11	What kind of ticketing service does your institution provide? (More than one answer is possible) *no need to answer if you have selected "no" for question 16
12	How do you control visitors' access? (more than one answer possible) *no need to answer if you have selected "no" for question 16
13	Do you have an informatic system that support these activities?
14	Which one of these marketing activities do you perform (internally or externally)? (More than one answer is possible)
15	Which social accounts does your museum have? (More than one answer is possible)
16	Is your museum listed on any of these review websites? (More than one answer is possible)
17	Are there any ideas or efforts in your museum to adapt to digital transformation?
18	In which digital activities did your museum invest in the last 2 years? (More than one answer can be selected)

4.2.2 Analysis of data in Phase 1

As shown in Chapter 4.2.1.1-3, the data collected in the 3 phases was. The converted data is used to calculate the number of agreements (NoA), and the content validity indices (I-CVI, S-CVI/Ave and S-CVI/UA). Table 4.7 depicts the content validity score of the

questionnaires for all three validations. According to Yusoff (2019), at least six or fewer than 10 experts for content validation were recommended for content validation. However, the Sarawak Museum Department assigned 2 museum experts to help the researcher validate the questionnaire. Thus, the researchers adopted the Davis (1992) approach where the accepted CVI value is at least 0.8. This means that the accepted score of the CVI of the DRQ must be at least 0.8, or the questions that fail to pass the accepted value will be removed or edited. Based on the Table 4.7, the scores CVI indices score in CV I does not pass 0.8 which leads the author to focus on the questions that need to be discuss with the museum experts during the interview to change the question structure to measure the respective dimension. Based on the responds of MEs in the interview, both MEs have similar perspective on digital readiness and one ME focus more on the digitisation. This may contribute to the low score of the CVI indices. After the author explains the focus of the study, both MEs understand that the questionnaire was for determine the digital transformation in terms of digital transformation and discussed the validity of the questions.

As for CV II, there are 6 I-CVI scores (0.5) and S-CVI/UA (0.684) did not pass 0.8. This led to the author to conduct CV III, where the 6 questions that scored 0.5 was modified with the discussion of museum experts via email. For the CVI indices of the CV III, only the I-CVI of Q4 and Q17 did not pass 0.8. The author decides to remove Q4 because it does not pass 0.8 in all three CV. Even though this question was modified in each CV, it still scored lower than the threshold value. For Q17, the question scored lower than 0.8 but it was the author's mistake in preparing the question. So, the modified question in Q17 in CV was changed to the correct question.

As an overall, the number of questions agreed to measure dimensions increases throughout the three CV. The finalized questions in Table 4.4 are added to the case study of

this research, which is divided into three sections: consent form, demographic form, and digital readiness questionnaire (Appendix D).

Table 4.7: Content Validity Score of the questionnaires for all three validations.

	Before Online Interview				After Online Interview (First time edit questions)				After Modifying the questions (Second Time Edit questions)			
Ques.	ME1	ME2	NoA	i-cvi	ME 1	ME 2	NoA	i-cvi	ME 1	ME 2	NoA	i-cvi
1	1	0	1	0.5	1	1	2	1	1	1	2	1
2	1	0	1	0.5	1	0	1	0.5	1	1	2	1
3	1	0	1	0.5	1	1	2	1	1	1	2	1
4	1	0	1	0.5	1	0	1	0.5	1	0	1	0.5
5	1	0	1	0.5	1	1	2	1	1	1	2	1
6	1	1	2	1	1	1	2	1	1	1	2	1
7	1	0	1	0.5	1	1	2	1	1	1	2	1
8	1	0	1	0.5	1	1	2	1	1	1	2	1
9	1	1	2	1	1	1	2	1	1	1	2	1
10	1	1	2	1	1	0	1	0.5	1	1	2	1
11	1	0	1	0.5	1	0	1	0.5	1	1	2	1
12	1	0	1	0.5	1	1	2	1	1	1	2	1
13	1	0	1	0.5	1	1	2	1	1	1	2	1
14	1	0	1	0.5	1	1	2	1	1	1	2	1
15	1	0	1	0.5	1	1	2	1	1	1	2	1
16	1	0	1	0.5	1	0	1	0.5	1	1	2	1
17	0	0	0	0	1	1	2	1	1	0	1	0.5

Table 4.7 continued

18	1	0	1	0.5	1	1	2	1	1	1	2	1
19	1	0	1	0.5	1	0	1	0.5	1	1	2	1
P.R	0.947 36842 1	0.157 8947 37	S-CVI/Ave (based on proportion relevance)	0.553	1	0.684 2105 26	S-CVI/Ave (based on proportion relevance)	0.842	1	0.8947 36842	S-CVI/Ave (based on proportion relevance)	0.947
			S-CVI/Ave (based on I- CVI)	0.553			S-CVI/Ave (based on I- CVI)	0.842			S-CVI/Ave (based on I- CVI)	0.947
			total agreement	3			total agreement	13			total agreement	17
			S-CVI/UA	0.158			S-CVI/UA	0.684			S-CVI/UA	0.895

4.3 Data Collection in Phase 2

In the second phase, the collected data included the demographic data and collected DRQ data. The duration of the researcher in collecting the responses from the museums in Malaysia was 4 months. Due to some museums being temporarily closed or permanently closed, the researcher was fortunate to collect 40 participants from museums or museum departments in Malaysia to respond to the online questionnaire and acquire the digital readiness of a total of 100 museums.

4.3.1 Demographic Data

The demographic information form helps the researcher keep track of which museums have responded to the online survey and learn about the participants and the number of visitors visiting the museum. Based on the collected data, 52.5% of the participants are male (21), and 47.5% are female (19). Figure 4.1 depicts the pie chart of the gender of the participants. According to the collected data, the occupation of each participant is different and are divided into few categories shown in Figure 4.2. The participants were asked to provide the name of the museum or museum department they are currently employed in (Figure 4.3). For the participants from museum departments, their response represented the museums they managed. For *Lembaga Muzium Negeri Sembilan*, it represents the four museums they managed, which are the Muzium Negeri Sembilan, Muzium Rajo Istano Lamo Sari Mananti, Muzium Rembau and Teratak Zaaba. As for the *Perbadanan Adat Melayu Dan warisan Negeri Selangor (PADAT)* managed a total of 5 museums, which are *Muzium Sultan Alam Shah*, *Muzium Gedung Raja Abdullah (Muzium Timah)*, *Muzium Insitu Jugra*, *Muzium Sabak Bernam*, and *Muzium Sejarah Daerah Kuala*

Selangor. The *Perbadanan Muzium Melaka (PERZIM)* manages 28 museums, which are *Muzium Istana Kesultanan Melaka, Muzium Sejarah dan Ethnografi, Muzium Pendidikan, Muzium Sastera Melaka, Galeri Laksamana Cheng Ho, Galeri Demang Abdul Ghani, Galeri Golf, Galeri Seni Rakyat, Balai Seni Lukis Melaka, Muzium TYT Yang Di-Pertua Negeri Melaka, Muzium Pemerintahan Demokrasi, Muzium Islam Melaka, Muzium Rakyat, Muzium Layang-Layang, Muzium Kecantikan, Muzium Belia Malaysia, Muzium Samudera Fasa I, Muzium Samudera Fasa II, Muzium Setem Melaka, Muzium Dunia Melayu Dunia Islam, Muzium Chetti, Muzium Pulau Besar, Muzium Kapal Selam, Muzium Hang Tuah, Muzium Orang Asli, Muzium Adat Istiadat, Muzium Sejarah Dan Warisan Naning, and Muzium Tentera Laut Diraja Malaysia (TLDM)*. As for the Department of Museums Malaysia (JMM), it manages a total of 20 museums, and the response of the IT officer represents the museums managed by his organization. There are 6 museums under the management of JMM that have responded individually; thus, the remaining museums follow the IT officer's response. For the Sarawak Department, there are 3 regional offices that manage the museums in Sarawak: where the northern regional office manages the *Muzium Petroleum Miri, Muzium Arkeologi Niah, Muzium Wilayah Limbang, and Muzium Wilayah Baram*, while the central regional office manages Fort Emma, Fort Lily and Fort Brooke. The southern regional office manages *Muzium Budaya Borneo, Muzium Sarawak, Muzium Sejarah Cina, Muzium Warisan Islam, Muzium Semulajadi, Muzium Seni Sarawak, Muzium Tekstil Sarawak, Muzium Warisan Sri Aman, Kubu Alice and Rumah Sri Aman Galeri*.

Furthermore, the participants were asked how many years they worked in the museum or museum department. Based on the bar chart (Figure 4.4), it is shown that most of the participants worked for more than 8 years (46.15%), while the least of the participants worked for 7-8 years (5.13%). Figure 4.5 depicts the annual number of visitors visiting the

museums in Malaysia according to the participants. It shows that there are 14 participants state that the museum visitors that visited their museum(s) are less than 10, 000 people. There are 2 participants that did not state the museums as one of the museums (Royal Malaysia Police Museum) do not track the number of visitors as there is no admission fee, while the other participants did not state the number of museum visitors but the number of visitors visiting the museums from the annual report of Malaysian Museum Department.

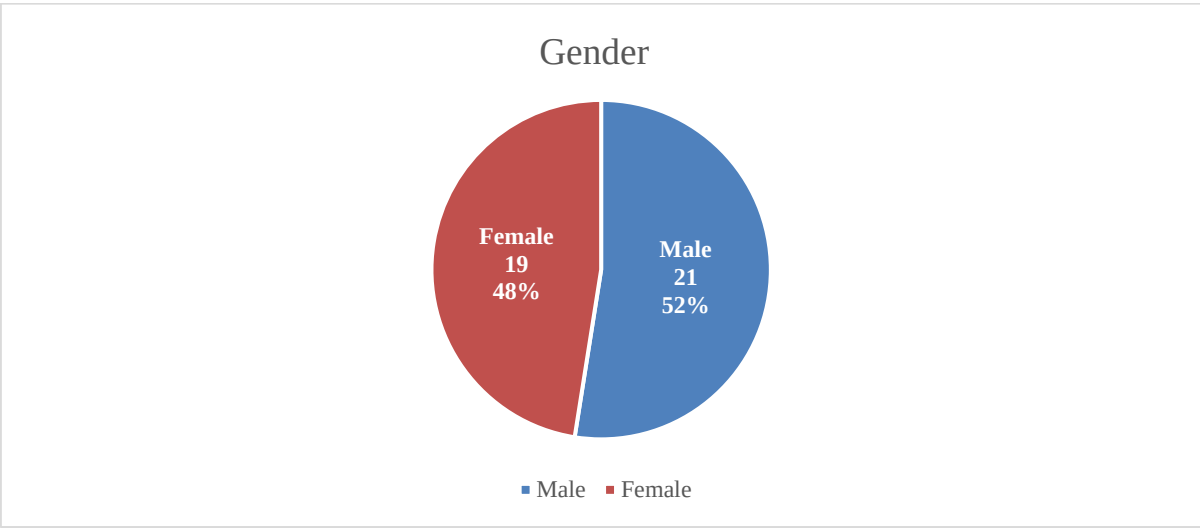


Figure 4.1: The Pie Chart of the Gender of the participants.

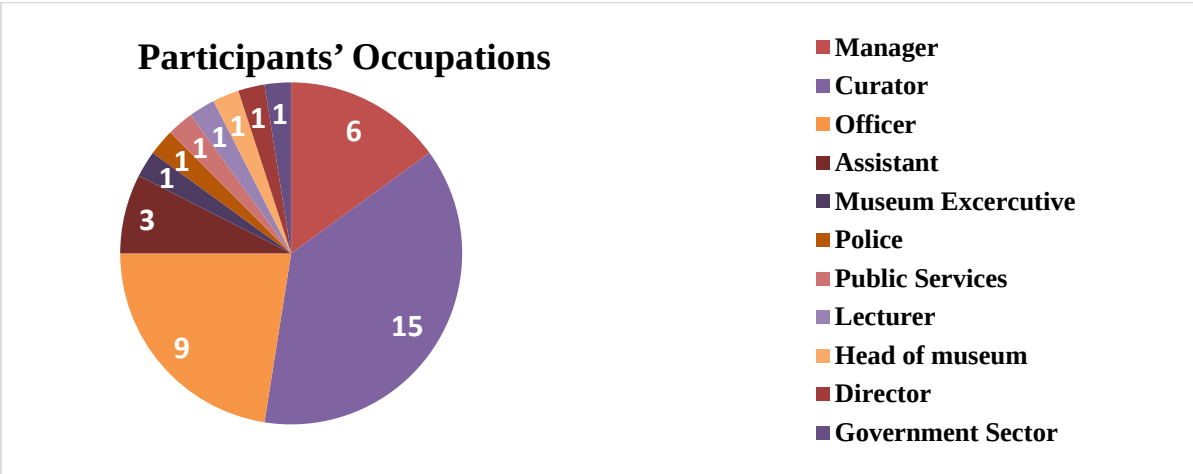


Figure 4.2: The participants' occupations

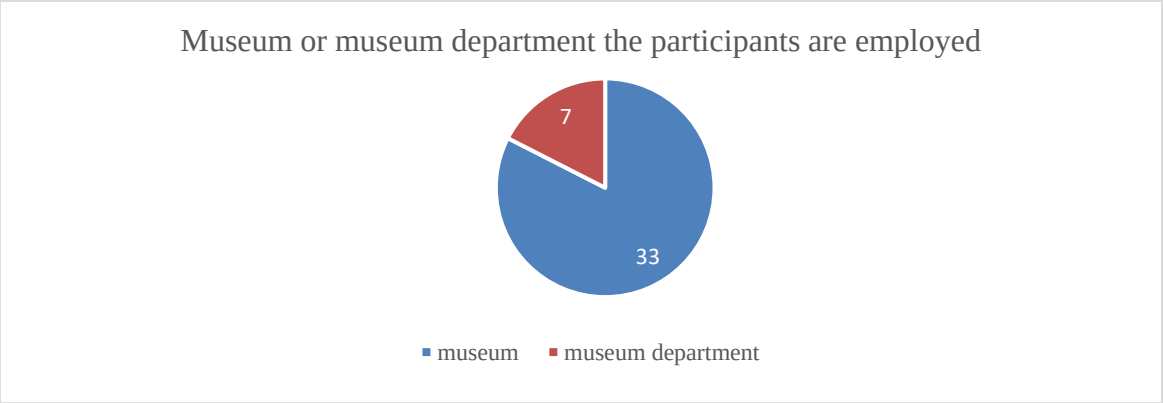


Figure 4.3: Museum or museum department the museum staff are employed

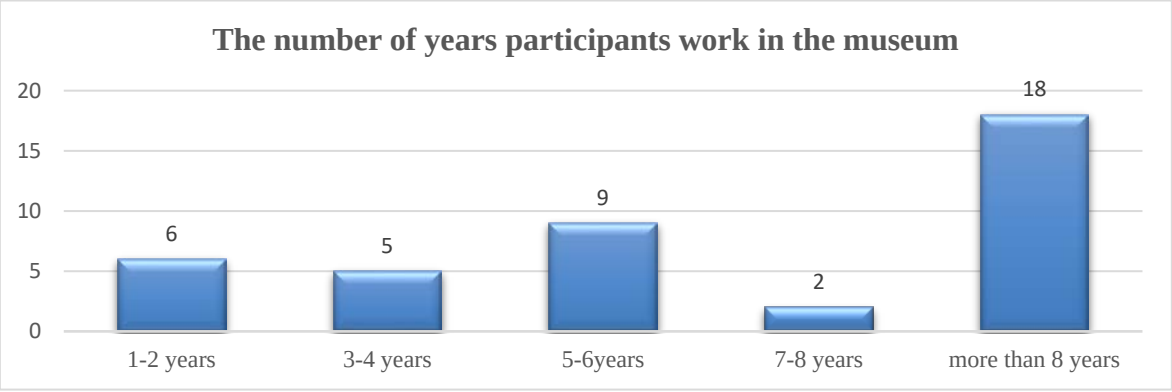


Figure 4.4: The Bar chart of the number of years the participants worked in the museum

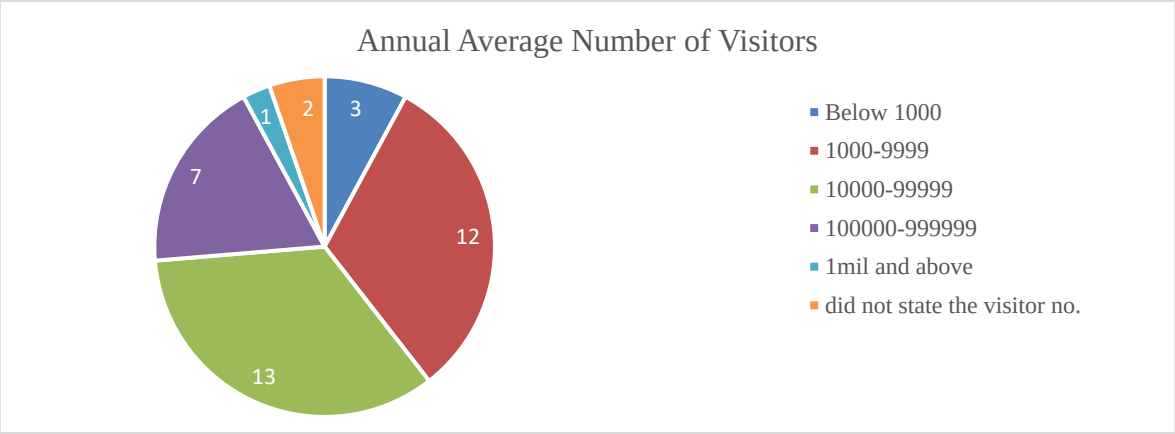


Figure 4.5: Annual Average Number of Visitors

4.3.2 Digital Readiness Questionnaire Data Collection

The data collected was analysed and calculated the score of each question (Q_k) based on the museums' response. The Digital Readiness Index (DRI) of museums were calculated as well in this section.

4.3.2.1 The Data Collection from DRQ

There are a total of 19 questions in the DRQ. The section will depict the selected options of all 19 questions by the participants before calculating the score of the questions (Q_k) in terms of the 5 dimensions.

i. People Dimension

In people dimension, it has 2 questions. For Q1, the participants were asked whether their institution have employees who specialize in information technology (IT). 80 % of the museums stated that they have some people in charge of managing digital activities, even if there is not a specialised team. 5 % of the museum state that they have external consultants while 3% of the museums state that they rely on a specialised team of X people in IT, where X stands for the number of people. However, there are also museums that stated they do not have employees that specialised in IT. The scores were later calculated in the next section (Chapter 4.3.2.2).

As for Q2, the museums were asked on the positions that specialised in IT present in their institution. Based on Figure 4.7, it shows that 58% of the museums does not present any of the listed positions. 42 % of the museums have one of the listed job positions. Among the listed positions, social media manager has the highest percentage (18%) while 'others' has the second highest (16%). Those museums that voted 'others' have stated the job positions they have that are related to the listed position, which are *Muzium Negeri Kedah*, *Muzium Sungai Lembing*, *Muzium Seni Kraf Orang Asli*, *Muzium Tekstil Negara*, *Muzium*

DiRaja, Muzium Kota Kayangan, Muzium Arkeologi Lembah Bujang, Muzium Kota Kuala Kedah, Galeria Perdana, Muzium Perak, Muzium Matang, Muzium Automobil Nasional, Muzium Lukut, Muzium Seni Bina Malaysia, and Muzium Kota Johor Lama. Muzium Negeri Kedah shared that they have a photographer and designer to manage the information on their museums' social media. In contrast, the other 15 museums shared that they have IT officer to manage the museum information digitally. From both questions, the researcher noticed that the majority museums lack in person in-charge that are specialised in IT as well as the listed occupations to manage the museums digitally.

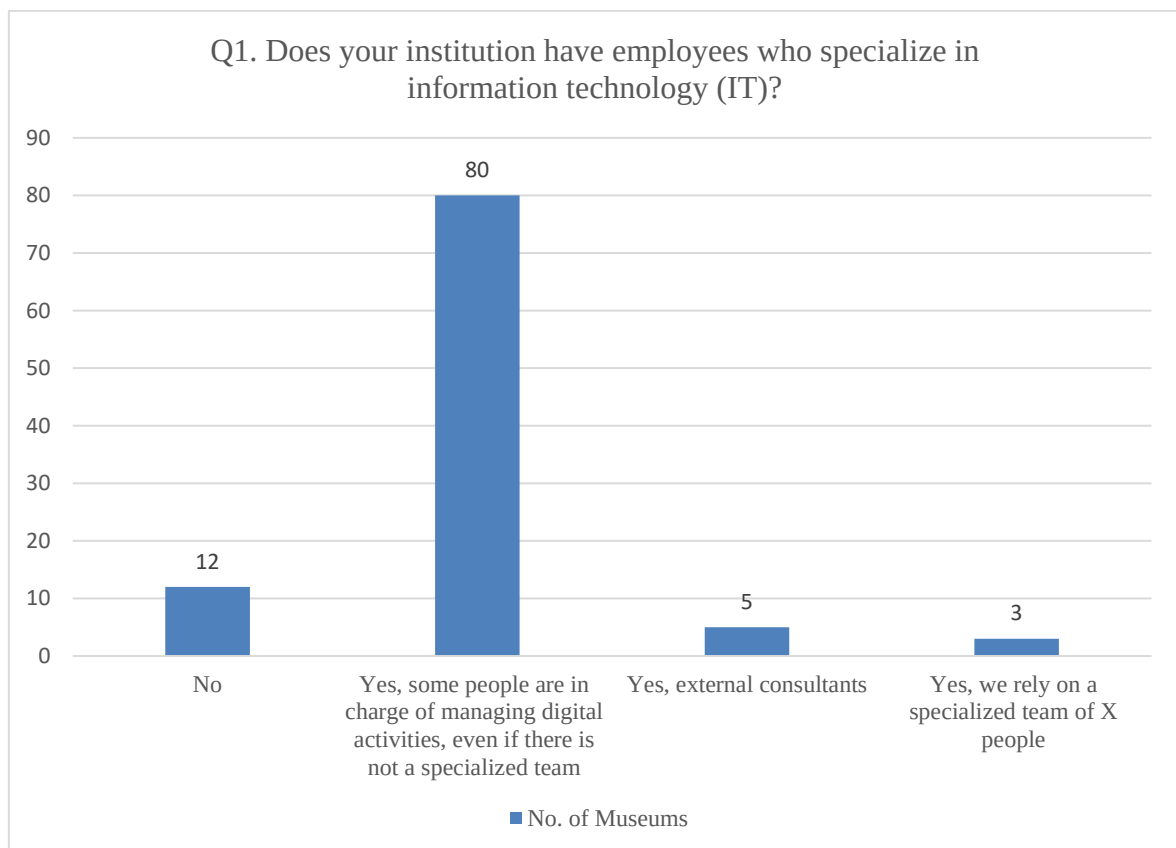


Figure 4.6: The The number of Malaysian museums that have or do not have employees who specialize in IT

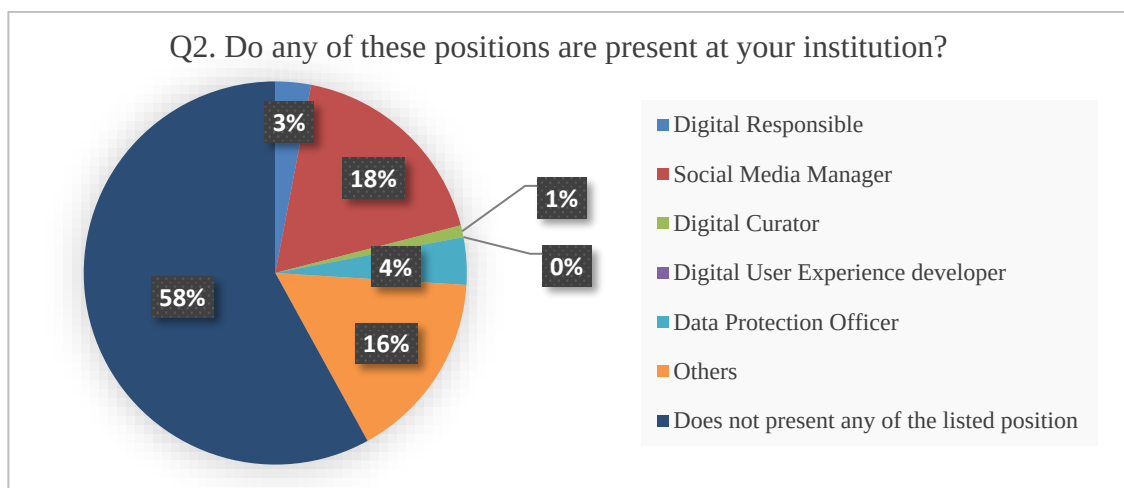


Figure 4.7: The pie chart of the number of museums that have the listed positions present at their institution.

ii. Technology Dimension

As for technology dimension, there are a total of 7 questions (Q3-Q9). In Q3, the museums were asked which technologies are present in their museums, and it is a multiple-choice question where museums can select more than one technology that are present in the museums. There are a total of 8 listed technologies in Q3, where each technology was divided into 3 selections to learn whether the technology is presented in the museums, would like to adopt it, or has the technology but decided to remove it. Figure 4.8 depicts the number of museums with the listed technologies in their museum and the technologies museums wish to adopt. Based on the bar chart, the technologies that has the highest number of museums adopt is interactive installations, second highest is QR code and third highest is 3D display or interactive panels. As this is multiple options question, the museum that adopted the most technologies (audio guide, Virtual Reality, QR Code, 3D Display or interactive panel, Interactive installation, Chatbot, & Gamification Stations) is *Kompleks Muzium Diraja Sultan Haji Ahmad Shah* while there are only 5 museum does not adopt all the listed Digital technologies. (Tun Jugah Museum and Gallery, *Galeri Arkeologi*, Chimney

Museum, *Muzium Adat/Custom Museum, Muzium Geologi*). Aside from that, 71 out of 100 museums shared that they wish to adopt some of the list technologies.

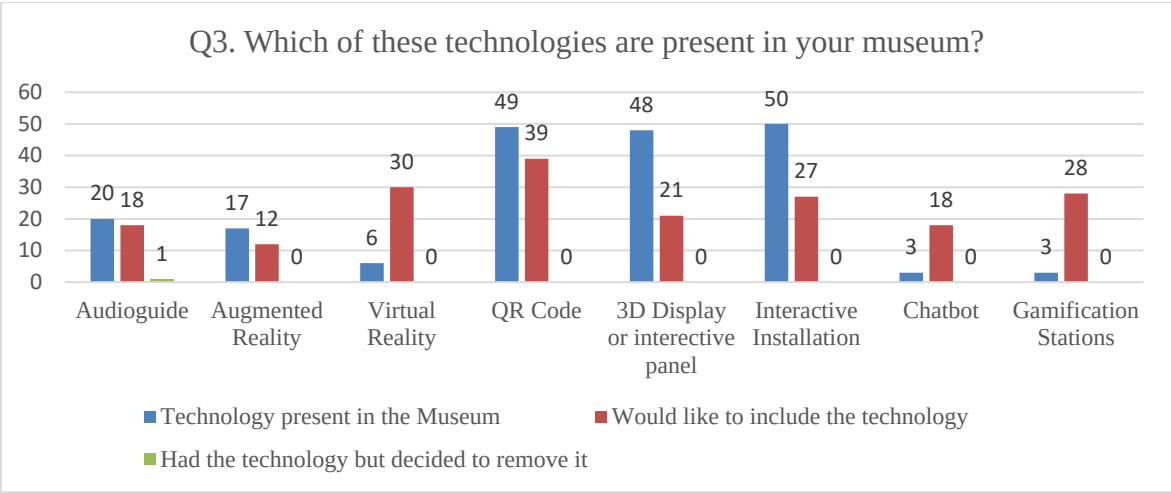


Figure 4.8: Bar Chart of the Number of museums that have the listed technologies present in their museum

In Q4, the museums were asked to what extend is their collection catalogued. There are three types of catalogue approach, which are paper catalogue, database catalogue, and catalogue using software. Figure 4.9 shows the graph of museums adopting paper catalogues, database catalogues and cataloguing using other software. Referring to the graph, there are only 12 museums that fully adopt paper catalogued, 11 museums adopt database catalogue and 23 museums that fully adopt cataloguing using software. Half of the museums (56) stated that they have adopt software to catalogue their collections using software. In addition, there are museums that use either a combination of two or three types of catalogues to catalogue their collections. Figure 4.10 depicts the number of museums that use paper catalogue, database catalogue, software catalogue, paper and database catalogue, database and software catalogue, all types of catalogues and none of the listed catalogue. There are 39% of the museums that adopt all 3 technologies for cataloguing their collections.

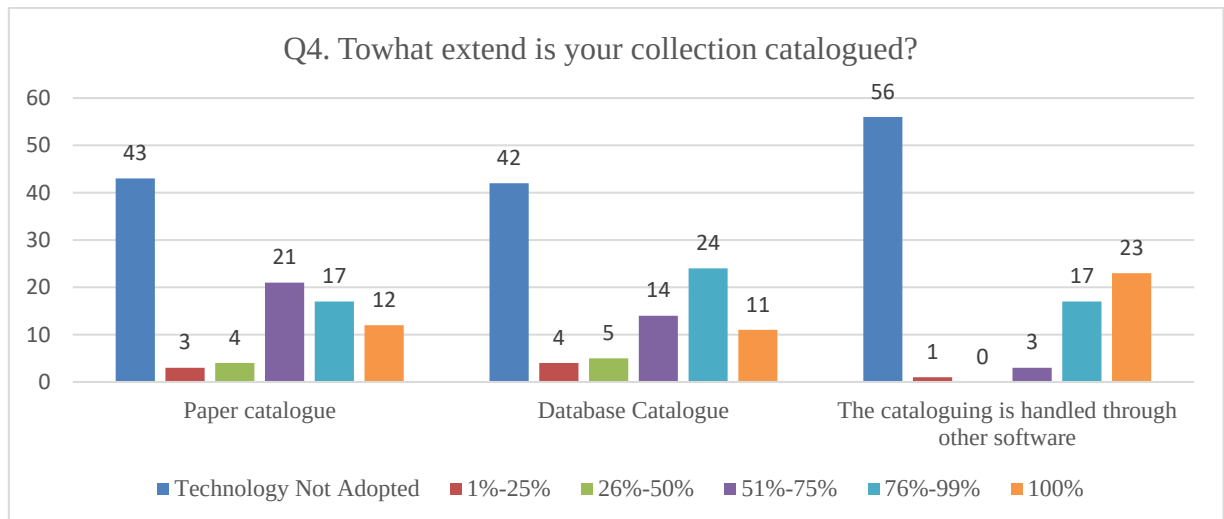


Figure 4.9: The extent of museum collections catalogued in Malaysian museums.

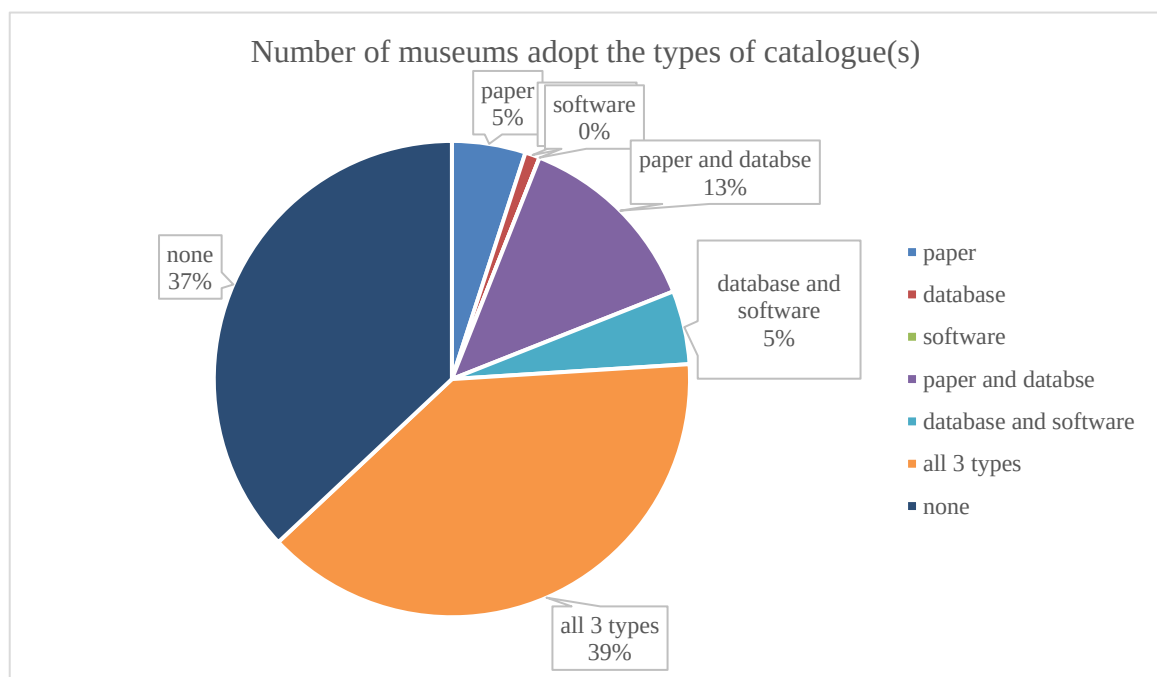


Figure 4.10: Pie Chart of the Number of Museums adopt the types of catalogue(s)

In Q5, it is a link to Q4. Figure 4.11 show the pie chart of the museums that listed the software they are using while Table 4.8 depicts the museums that adopted other software for cataloguing and the name of the software they used. There are 19 museums that did not state the software, while 25 museums stated the software they adopted. The software used by those museums are Google Sheets, Google Docs, Internet, Facebook, MUSIMs

Collection Management System, PADAT integrated inventory system, MUSECORE System, and Sarawak Museum Collection Management System. However, there are also museums that state the software they use to catalogue their collections even though they share that they do not adopt software to catalogue their collections in Q4, where *Muzium Petaling Jaya* adopted the Wilmu System (a library management system), Lau King Howe Hospital Memorial Museum provided information for their advertiser but don't know what software they use, and *Galeri Arkeologi* uses Microsoft Word. However, the author will only focus the 44 museums that state they have adopt other software for cataloguing in Q4 as the purpose of Q5 to acknowledge the type of software the local museums use for cataloguing in Q4.

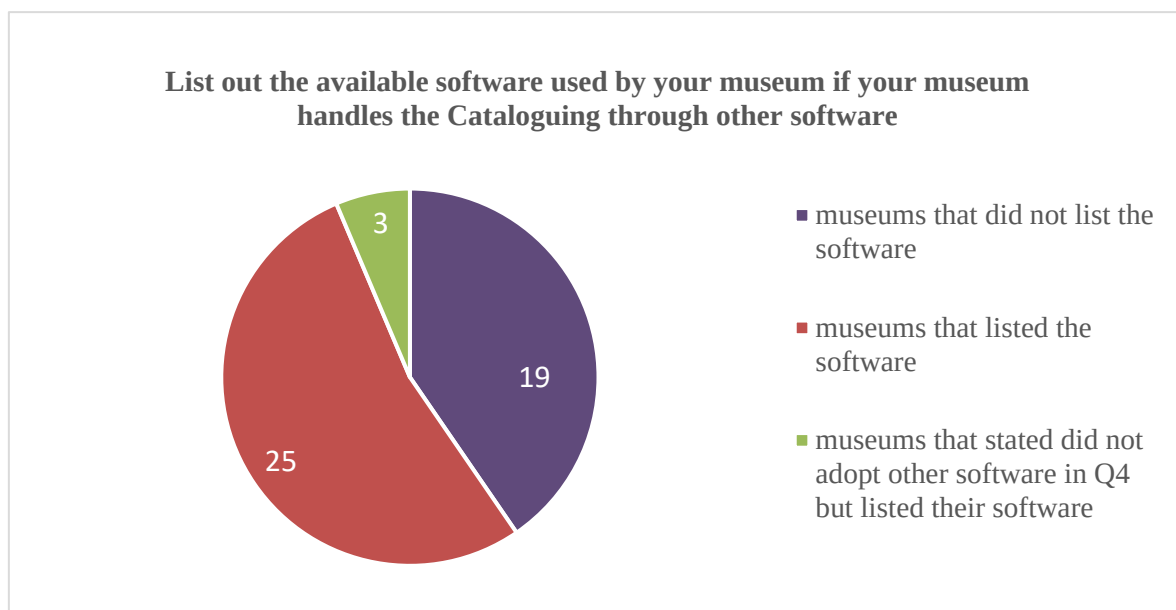


Figure 4.11: Software Used by Local Museums

Table 4.7: The type of museums that adopted other software for cataloguing their collections and the types of software.

Type of Museums	Museum's response	Answer in Q4	Feedback from Researcher
<i>Muzium Orang Asli Gombak</i>		76%-99%	does not state the system even though the museum catalogue is handled through other software.
<i>Muzium Perhutanan Negeri Pulau Pinang</i>		51%-75%	does not state the system even though the museum catalogue is handled through other software.
Johor Bahru Chinese Heritage Museum		51%-75%	does not state the system even though the museum catalogue is handled through other software.
The Royal Press	using google sheet and google docs.	76%-99%	
Army Museum	Internet, Facebook	76%-99%	
<i>Muzium Negeri Sembilan</i>	None	76%-99%	does not state the system even though the museum catalogue is handled through other software.

Table 4.8 continued

<i>Muzium Rajo Istano Lamo Sari Mananti</i>	None	76%-99%	does not state the system even though the museum catalogue is handled through other software.
<i>Muzium Rembau</i>	None	76%-99%	does not state the system even though the museum catalogue is handled through other software.
<i>Teratak Zaaba</i>	None	76%-99%	does not state the system even though the museum catalogue is handled through other software.
Islamic Arts Museum Malaysia	MUSIMs collection management system	100%	
<i>Muzium Sultan Alam Shah</i>	padat integrated inventory system	100%	
<i>Muzium Gedung Raja Abdullah (Muzium Timah)</i>	padat integrated inventory system	100%	

Table 4.8 continued

<i>Muzium Insitu Jugra</i>	padat integrated inventory system	100%	
<i>Muzium Sabak Bernam</i>	padat integrated inventory system	100%	
<i>Muzium Sejarah Daerah Kuala Selangor</i>	padat integrated inventory system	100%	
<i>Kompleks Muzium Diraja Sultan Haji Ahmad Shah, Kuantan</i>		76%-99%	does not state the system even though the museum catalogue is handled through other software.
National Museum		51%-75%	does not state the system even though the museum catalogue is handled through other software.
<i>Sungai Lembing Museum</i>		1%-25%	does not state the system even though the museum catalogue is handled through other software.

Table 4.8 continued

<i>Muzium Seni Kraf Orang Asli</i>	MUSECORE System	100%	
<i>Muzium Etnologi Dunia Melayu</i>	MUSECORE System	100%	
<i>Muzium Tekstil Negara</i>	MUSECORE System	100%	
<i>Muzium DiRaja</i>	MUSECORE System	100%	
<i>Muzium Kota Kayangan</i>	MUSECORE System	100%	
<i>Muzium Arkeologi Lembah Bujang</i>	MUSECORE System	100%	
<i>Muzium Kota Kuala Kedah</i>	MUSECORE System	100%	
<i>Galeria Perdana</i>	MUSECORE System	100%	
<i>Muzium Perak</i>	MUSECORE System	100%	

Table 4.8 continued

<i>Muzium Matang</i>	MUSECORE System	100%	
<i>Muzium Automobil Nasional</i>	MUSECORE System	100%	
<i>Muzium Lukut</i>	MUSECORE System	100%	
<i>Muzium Seni Bina Malaysia</i>	MUSECORE System	100%	
<i>Muzium Kota Johor Lama</i>	MUSECORE System	100%	
<i>Fort Lily, Betong</i>	Sarawak Museum Collection Management System	100%	
<i>Fort Emma, Kanowit</i>	Sarawak Museum Collection Management System	100%	

Table 4.8 continued

<i>Fort Brooke, Julian</i>	Sarawak Museum Collection Management System	100%	
<i>Muzium Budaya Borneo</i>		76%-99%	does not state the system even though the museum catalogue is handled through other software.
<i>Muzium Sarawak</i>		76%-99%	does not state the system even though the museum catalogue is handled through other software.
<i>Muzium Sejarah Cina</i>		76%-99%	does not state the system even though the museum catalogue is handled through other software.
<i>Muzium Warisan Islam</i>		76%-99%	does not state the system even though the museum catalogue is handled through other software.
<i>Muzium Semula Jadi</i>		76%-99%	does not state the system even though the museum catalogue is handled through other software.

Table 4.8 continued

<i>Muzium Seni Sarawak</i>		76%-99%	does not state the system even though the museum catalogue is handled through other software.
<i>Muzium Tekstil Sarawak</i>		76%-99%	does not state the system even though the museum catalogue is handled through other software.
<i>Muzium Warisan Sri Aman, Kubu Alice</i>		76%-99%	does not state the system even though the museum catalogue is handled through other software.
<i>Rumah Sri Aman Galeri</i>		76%-99%	does not state the system even though the museum catalogue is handled through other software.

In Q6, the museums were asked whether they gathered data about visitors. Figure 4.12 shows the number of museums voted for one of the listed options of Q6. According to the chart, 51% of the museums use paper to gather their visitors' data, while the second highest percentage (32%) is museums that use appropriate software to collect their visitors' data. Only the Malacca Heritage Centre, Lau King Howe Hospital Memorial Museum, Johor Bahru Chinese Heritage Museum, The Royal Press, and Royal Malaysia Police Museum do not gather visitor data.

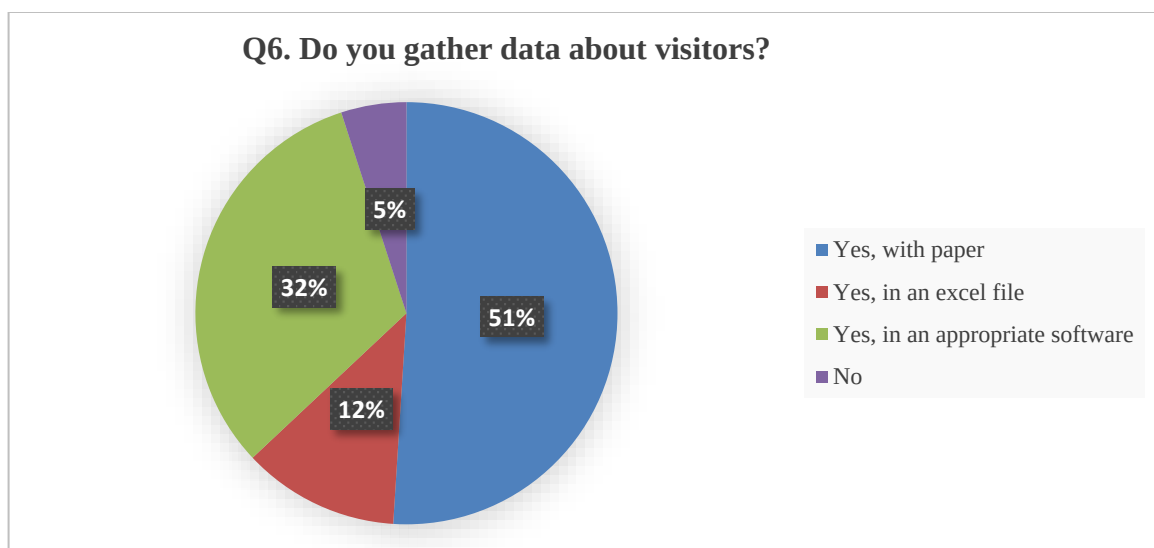


Figure 4.12: The pie chart of Malaysian museums gathers data about visitors.

In Q7, the museums were asked whether they monitor the data about their museum's social network channels. Based on the collected data, 59% of the museums monitor the data about their museum's social channels, while 41% of the museums do not monitor (Figure 4.13).

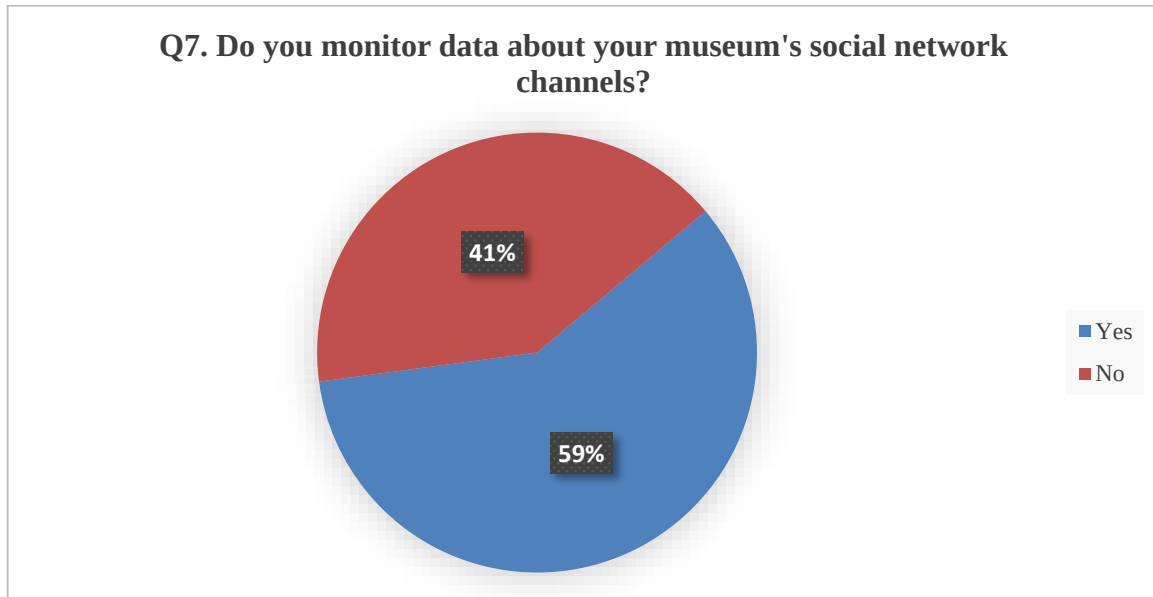


Figure 4.13: The Chart of the museums that monitor the data of their social channels.

The next question, Q8, the museums were asked whether they monitor data for online reviews. 58% of the museums stated that they monitor data for online reviews, while 42% of museums do not monitor (Figure 4.14).

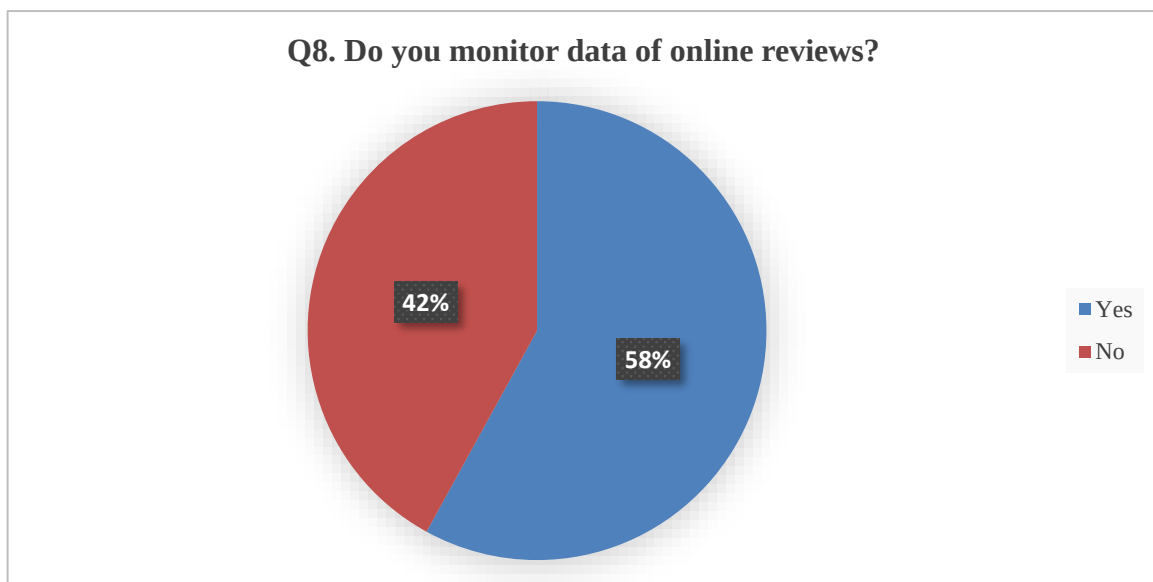


Figure 4.14: The chart of museums that monitor data for online reviews.

Q9 asked whether the museums have a Wi-Fi connection. Based on the collected data, 89% of the museums have a Wi-Fi connection, while 11% of the museums do not

(Figure 4.15). This dimension allow the researcher to acknowledge the types of technologies adopted by the museums, types of catalogued collection, gather data about the visitors, monitor data of social network channels along with online review as well as the Wi-Fi connectivity in museums.

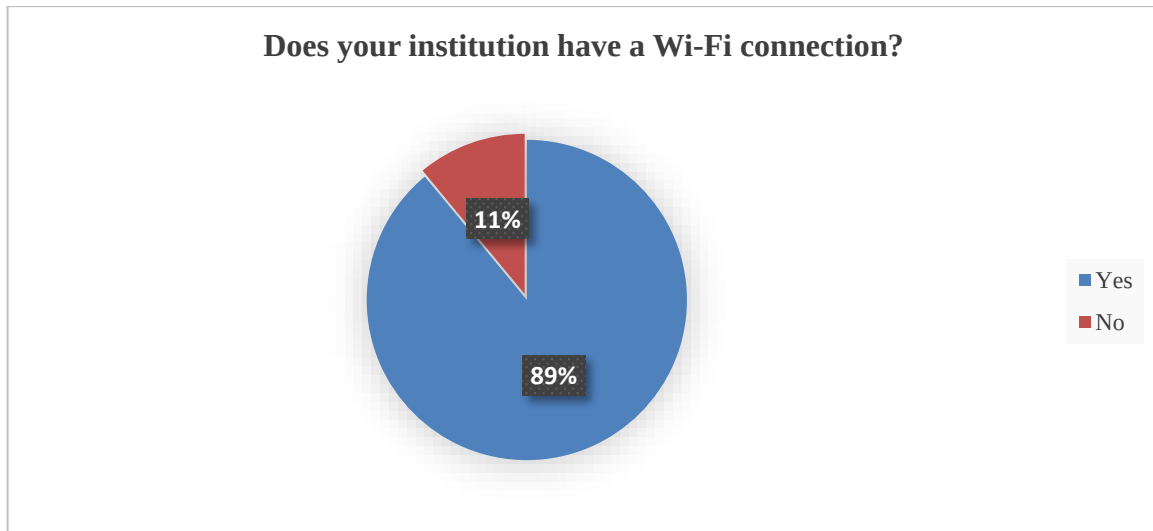


Figure 4.15: The chart of Malaysian museums having Wi-Fi connection.

iii. Process Dimension

For this dimension, it consists of 4 questions (Q10-Q13). In Q10, the museums were asked whether their institution had a ticketing service. According to Figure 4.16, 70% of museums have ticketing systems at their institutions while the remaining 30% do not. This question does not have a score and is linked to Q11 and Q12. For the 30% of museums that stated they do not have a ticketing system, they do not need to answer Q11 and Q12.

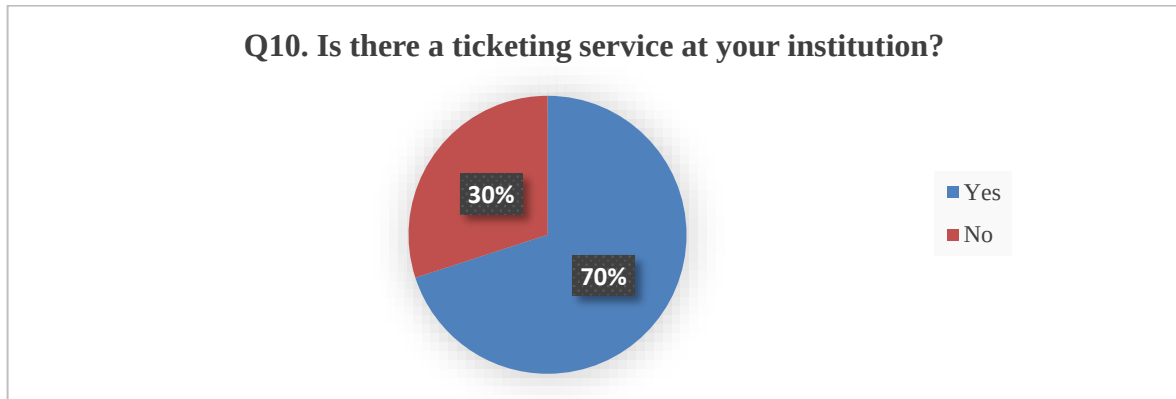


Figure 4.16: The chart of Malaysian museums having a ticketing service.

In Q11, 70% of museums that stated they have ticketing systems were asked about the kind of ticketing service the museums provide. There are a total of 4 options for the museums to select. Figure 4.17 depicts the number of museums that provided the listed options. As Q11 is a multiple-choice question, museums can choose more than one type of ticketing service. Among the 70 museums, there are 30 museums that adopt more than one type of ticketing systems, where there are 29 museums adopt ‘paper bill and paper accounting & e-ticket printable at home’ and 1 museums adopt ‘paper bill and paper accounting & paper bill and digitalized invoice’.

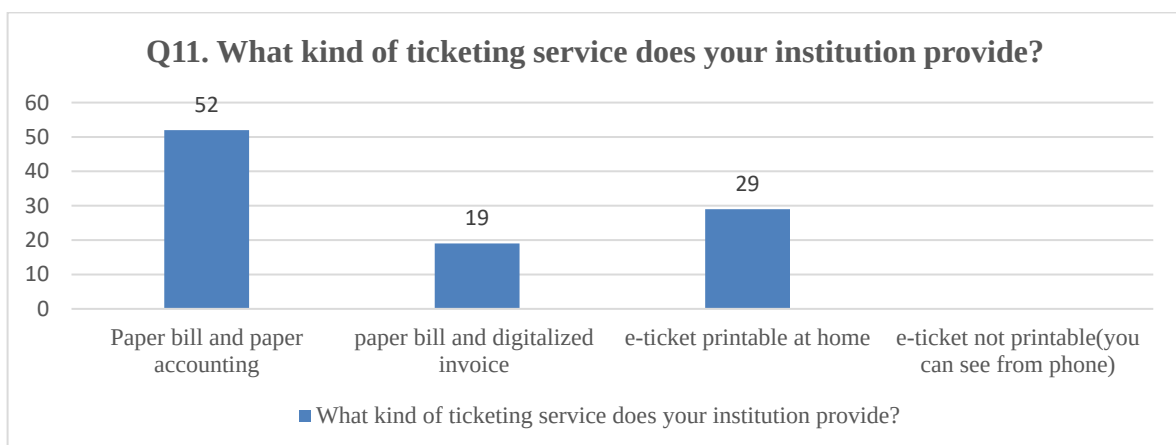


Figure 4.17: The number of museums that provided the listed options.

For Q12, 70% of the museums with ticketing systems were asked whether they control visitors' access. They can select more than one option. There are a total of 9 options, and the option with the most number of museums selected is paper ticket control at the entrance (Figure 4.18). The second highest option selected by museums is a QR code reader. As it is a multiple choice questions, there are 14 museums that adopt more than one method in controlling their visitor access.

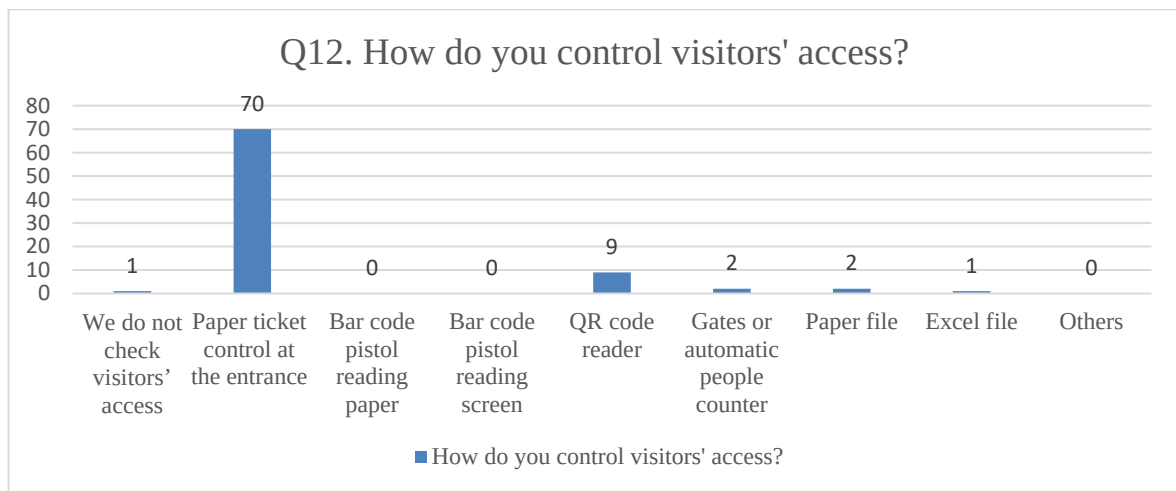


Figure 4.18: The number of museums and the types of methods controlling visitors' access.

As for Q13, the museums were asked whether they have an informatic system that supports activities, which are accounting, supplier management, human resources, customer information management (CRM), cataloguing, conservation and ordinary maintenance of collections, lending and moving of artworks, space management, public services (e.g. bookshop, restaurant), teaching activities, as well as ticketing. Figure 4.19 shows the number of museums with an informative system supporting activities. In summary, there are few museums that have informative system that supports more than one listed activity. The highest number of museums have informative system that supports all 10 activities is 35, while the second highest is 6 activities. The museums that did not have informative systems

for all 10 activities are STIDC Timber Museum, *Muzium Orang Asli Gombak*, Lau King Howe Hospital Memorial Museum, Royal Malaysia Polic Museum, Museum of Art and Marine Museum Labuan.

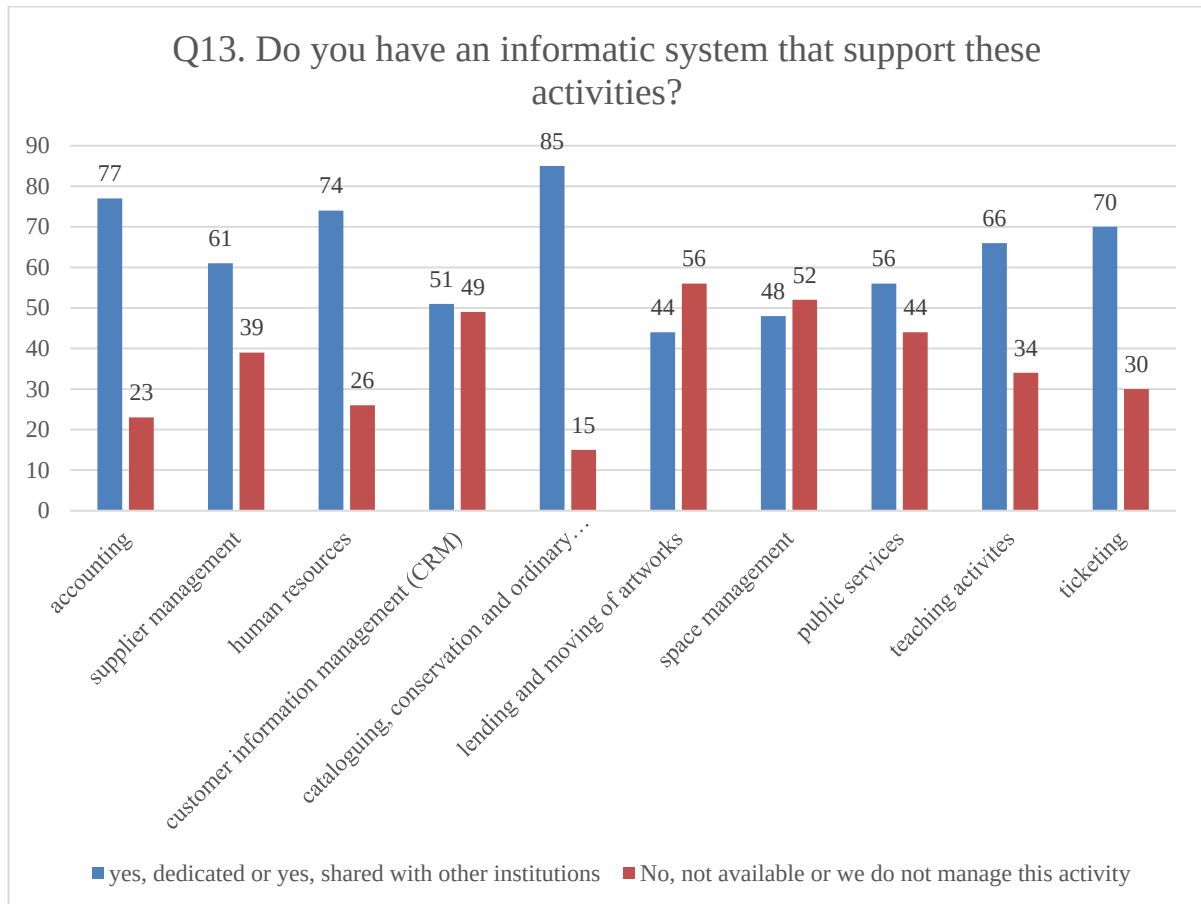


Figure 4.19: The number of museums that have an informative system that supports the listed activities

iv. Customer Dimension

In customer dimension, the data help researchers to learn museums approach in promoting to interact with their visitors. This dimension consists of 3 questions (Q14-Q16) For Q14, the museums were asked to select one or more options (marketing activities) they performed internally or externally. The options are newsletter, online/social network advertising, website, use of social media to convey internet traffic towards the website or

other marketing practices and none. Based on the collected data (Figure 4.20), the website and online/social networking advertising are the marketing practices that are mostly selected by the museums (95 museums each). As it is a multiple-choice question, there are museums (8) that performs all 4 activities, STIDC Timber Museum, Lau King Howe Hospital Memorial Museum, Islamic Arts Museum Malaysia. *Muzium Sultan Alam Shah*, *Muzium Gedung Raja Abdullah (Muzium Timah)* and *Muzium Insitu Jugra*.

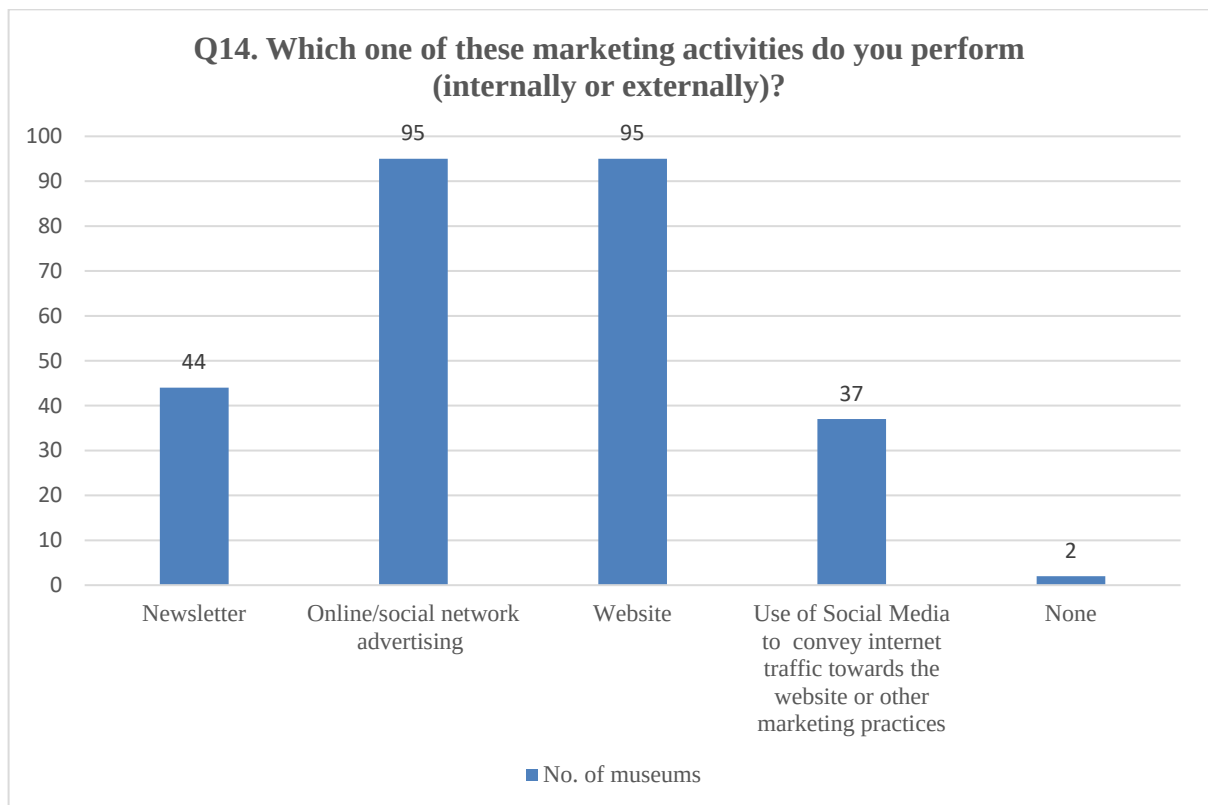


Figure 4.20: The graphs of museums' marketing activities.

For Q15, museums were asked whether they have social accounts like Facebook, Twitter, Instagram, YouTube, Pinterest, or TikTok. From the data collected, most Malaysian museums have the top three social accounts: Facebook, Instagram, and TikTok (Figure 4.21). There are a total of 7 museums that do not have any of the listed social accounts, which are, which are Malacca Heritage Centre, *Muzium Perhutanan Kedah*, *Muzium Petroleum*,

Muzium Arkeologi Niah, Muzium Wilayah Limbang, Muzium Wilayah Baram and Muzium Geologi. Aside from that, there are 24 museums that own 5 accounts and none of the museums have Pinterest accounts.

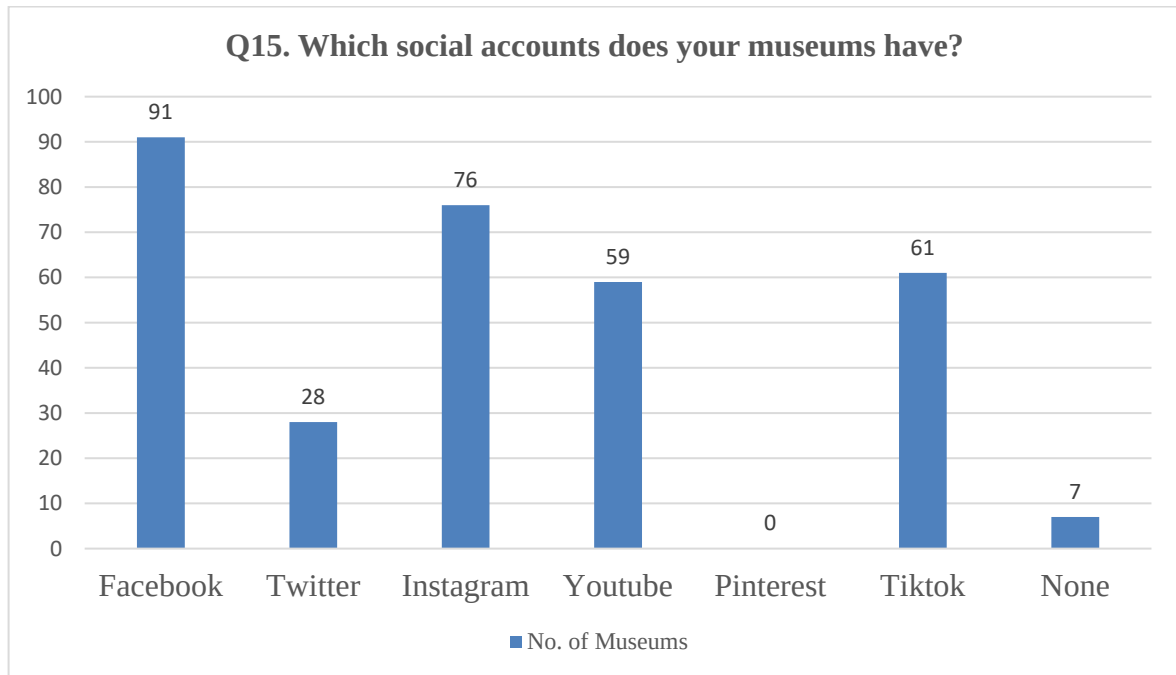


Figure 4.21: The number of museums and the social accounts they have.

Moving on to Q16, the museums were asked whether they are listed on any review websites, like TripAdvisor, Google Maps, Facebook Place, and Foursquare. Among the four review websites, the review website with the greatest number of museums is Google Maps (97 museums), followed by TripAdvisor (78 museums) (Figure 4.22). There are a total of 44 museums that stated they are listed on all 4 review websites. Only one museum stated that they are not listed on any of the four review websites, which is *Muzium Negeri Kedah*. However, the name of the museum can be found in Google Maps as well as the two other museums (Malacca Heritage Centre and *Kompleks Muzium Diraja Sultan Haji Ahmad Shah*) that state that they are not listed in Google Maps.

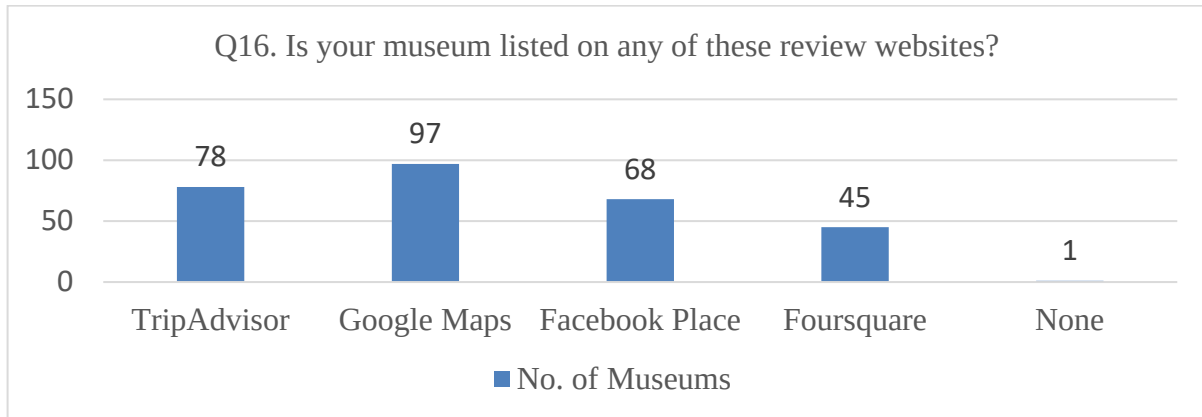


Figure 4.22: The types of review websites and the number of museums listed on the review websites.

v. Strategy and Investment Dimension

Most museums have their strategy to adapt to digital transformation and they have invest in projects that adapt to digital transformation. There are 3 questions in this dimension. In Q17, the museums were asked whether they have ideas or efforts in their museums to adapt to digital transformation. Figure 4.23 shows that 71% of museums have stated that they have a dedicated document to adapt to digital transformation, 25% museums have another document to adapt to digital transformation and 4% of the museums do not have any ideas or efforts to adapt to digital transformation.

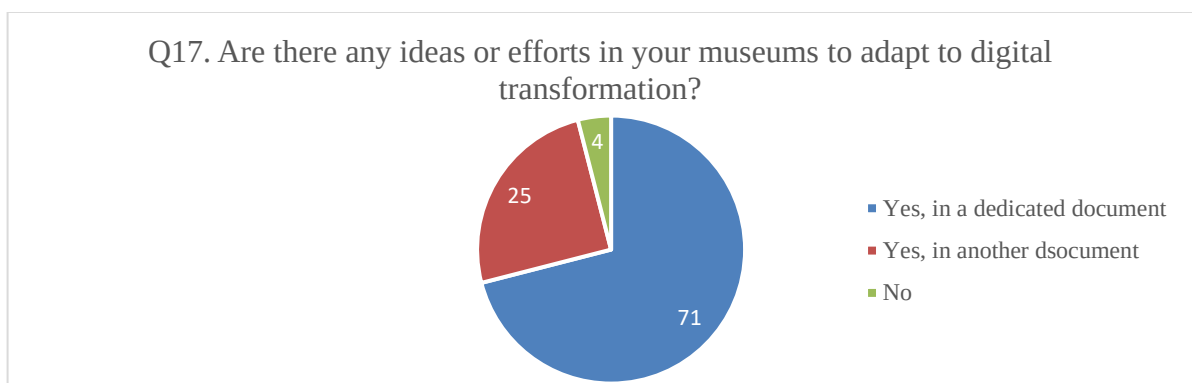


Figure 4.23: The number of museums that have ideas or efforts in their museums to adapt to digital transformation.

For Q18, the museums were asked whether they have invested in the last 2 years in digital activities, which are ‘cataloguing and digitization of collection’, ‘conservation of collection’, ‘services of visit support’, ‘communication and customer care’, ‘ticket, booking and access control’, ‘security and surveillance’, as well as ‘Education activities’, Figure 4.24 shows that 70% of the museums have invested in ‘security and surveillance’ and ‘education activities’ in the last 2 years. The second highest digital activity invested by museums is the conservation of collections (60%).

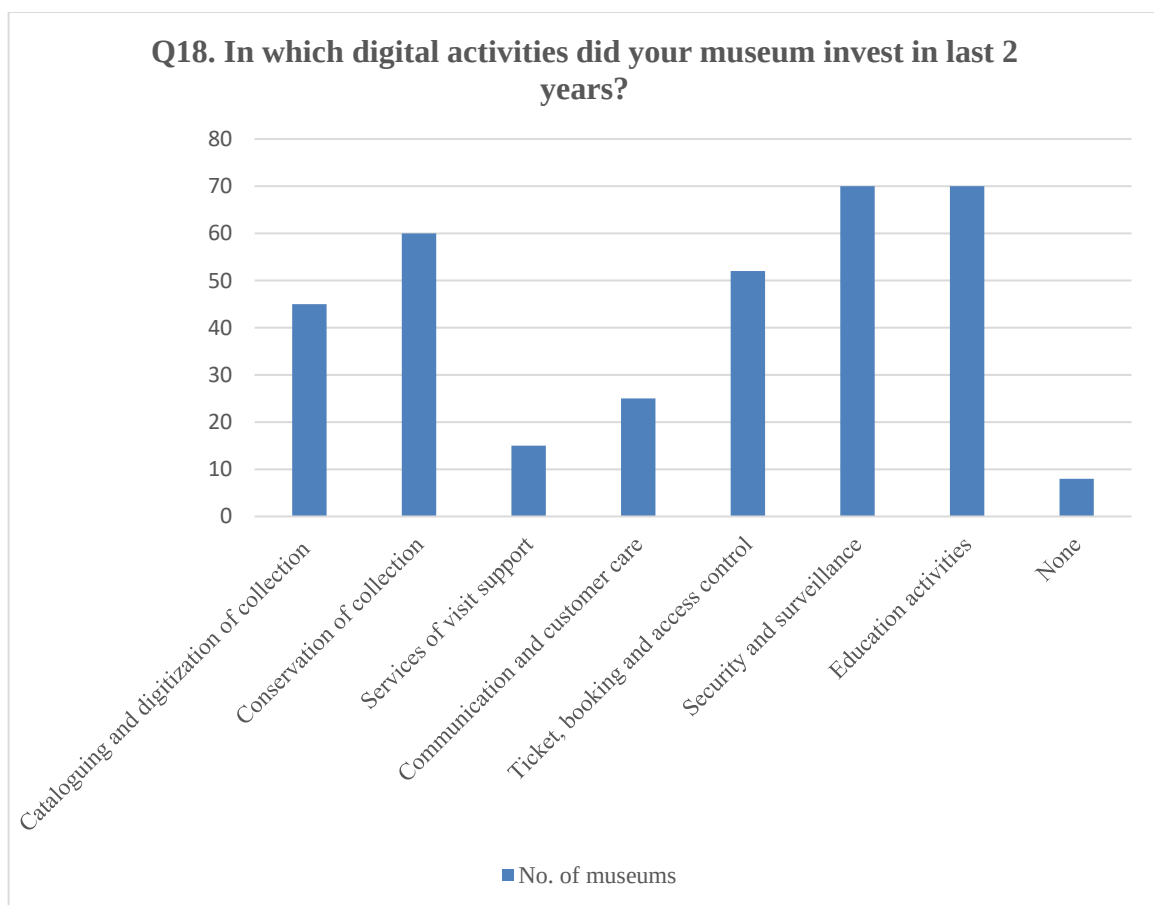


Figure 4.24: The digital activities invested by Malaysian museums in last 2 years.

As for the last question, Q19, museums were asked the estimated percentage the museum invests in digital innovation. Based on Figure 4.25, most museums have invested 51% -75% of their museum investment in digital innovations (53%). In comparison, 4% of

the museums, including the Chimney Museum, *Muzium Adat*, *Muzium Geologi* and Marine Museum Labuan, have not invested in digital innovation. There are 5% museums that invest more than 75% in digital innovation, which are Malacca Heritage Centre, *Kompleks Muzium Diraja Sultan Haji Ahmad Shah*, Fort Lily, Fort Emma and Fort Brooke.

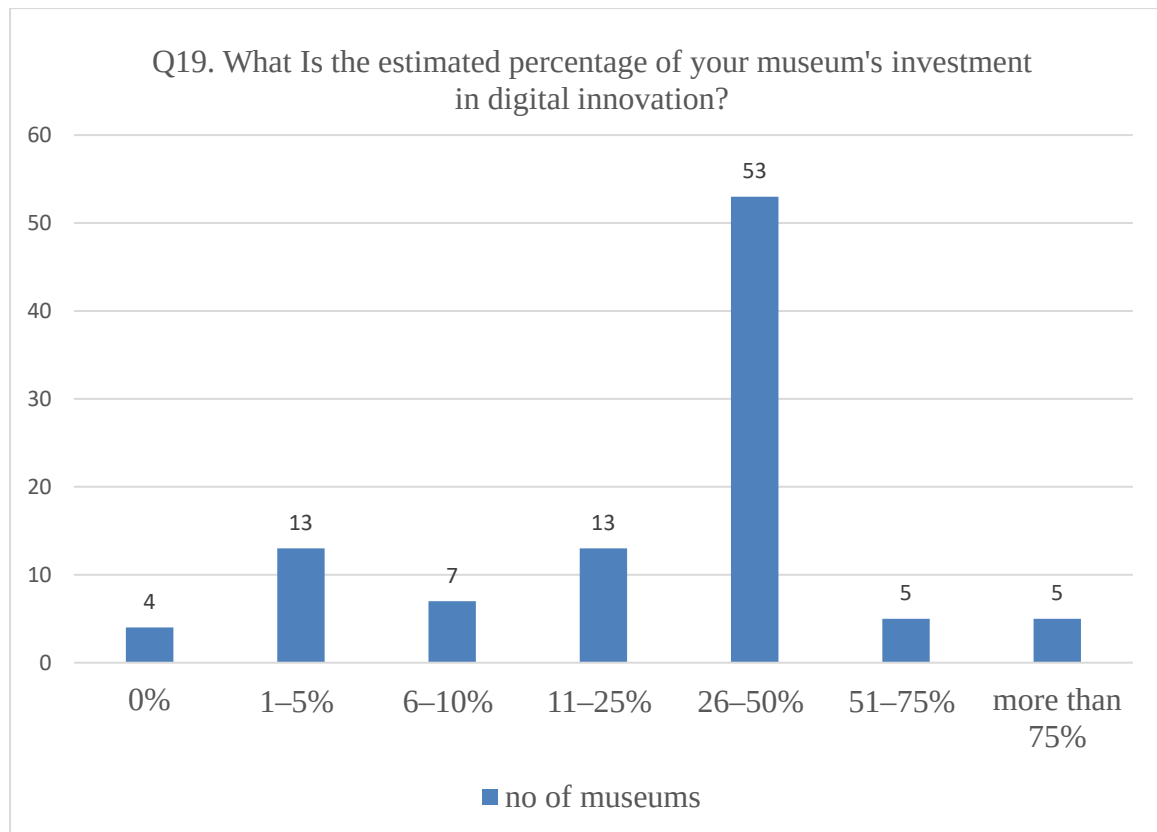


Figure 4.25: The estimated percentage of museums' investment in digital innovation.

4.4 The Data Analysis in Phase 2

The score of the questions (Qk) and the digital readiness index(DRI) of the museums are analysed using descriptive analysis.

4.4.1 The score of questions (Qk)

Before calculating the DRI score of each museum, the score of each question (QK) was converted and calculated depending on the types of questions. Table 4.9 depicts the Qk of all 19 questions. The author mentioned the number of museums that scored the highest

and lowest in this section. For people dimension, the number of museums that score full marks is 3 while museums that score 0 is 12 in Q1. As for Q2, there are 42 museums that score full marks while 58 museums scored 0.

For technology dimensions, the museums that scored the highest is Army Museum (0.84), second highest is National Museum and *Kompleks Muzium Diraja Sultan Haji Ahmad Shah* (0.72). As mentioned in Chapter 4.3.2.1 ii., the museum that adopted the most museums is *Kompleks Muzium Diraja Sultan Haji Ahmad Shah* but it was not the highest due to Army Museum have adopt 6 technologies and 3 type of technologies that they would like to adopt. In Q4, the museums that scored the highest is 0.99, which are *Muzium Sultan Alam Shah*, *Muzium Gedung Raja Abdullah (Muzium Timah)*, *Muzium Insitu Jugra*, *Muzium Sabak Bernam* and *Muzium Sejarah Daerah Kuala Selangor*. For Q5, the question does not have score. In Q6, there are 32 museums that score full marks and 5 museums that score 0. The full marks for Q7 is 0.5, where there are 59 museums that scored it and 41 museums that scored 0. Same like Q7, the full marks in Q8 is 0.5. The number of museums that scored 0.5 in Q8 is 58, while 42 museums scored 0. For Q9, the number of museums that scored 1 is 89, while 11 museum scored 0.

In process dimension, Q10 does not have score. Q11 highest score is 0.3 (29 museums) and 22 museums scored 0. As for Q12, the highest score is 0.19 where there is 11 museums scored that score and 58 museum scored 0. The full score of Q13 is 1, where 35 museums scored that mark and 6 museums scored 0.

In customer dimension, only 8 museums scored the highest for Q14 (1) and the number of museums that scored the lowest (0) is 2 museums. For Q15, the highest score is

0.85 (24 museums) and the lowest score is 0 (7 museums). Q16 showed that there 44 museum that scored 1 (full score) and only 1 museum that scored 0.

In strategy and investment dimension, the full score of Q17 to Q19 is 1. Q17 showed that there are 71 museums that scored 1 while 4 museums scored 0. Q18 depicts the number if museum scored full is 3 while 5 museums scored 0. In Q19, the number museum that scored full is 5 while the number of museums that scored 0 is 17. The Qk were calculated and proceed to the next step, which is calculate the dimension scores and DRI of museums.

Table 4.8: The Score of the digital readiness questions (Qk).

The Score of the digital readiness questions (Qk).																			
Museums	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19
Malacca Heritage Centre	0	0	0.15	0.198		0	0	0	1	No			0.2	0.3	0	0.25	0.8	0.286	1
STIDC Timber Museum	0.5	0	0.37	0.33		0.5	0	0.5	1	No			0	0.1	0.3	0.5	0.8	0.143	0.4
Tun Jugah Museum and Gallery	0.5	0	0	0.132		0.1	0.5	0.5	1	No			0.4	0.8	0.15	0.25	0.8	0.286	0.2
Muzium Perhutanan Negeri Kedah	0	1	0.05	0.33		0.1	0	0	0	No			0.3	0.3	0	0.25	1	0	0
<i>Muzium Orang Asli Gombak</i>	0.5	1	0.15	0.528		0.5	0.5	0.5	1	No			0	0.5	0.15	0.75	0.8	0.429	0.2
Sabah and Sarawak Judicial Museum	0.5	1	0.09	0.528		0.1	0.5	0.5	1	No			0.3	0.5	0.15	0.25	1	0.286	0.4
<i>Muzium Warisan Lipis</i>	0.5	1	0.16	0.198		0.5	0.5	0.5	1	Yes	0.3	0.14	0.4	0.8	0.55	0.5	0.8	0.286	0.6
Ho Yan Hor Museum	0.5	0	0.1	0.33		0.5	0.5	0.5	1	No			0.3	0.75	0.3	0.75	1	0.286	0

Table 4.9 continued

Muzium Petaling Jaya, Majlis Bandaraya Petaling Jaya	1	0	0.08	0.264		0.1	0.5	0.5	1	No			0.5	0.3	0.15	0.5	0.8	0.429	0.2
LAU KING HOWE HOSPITAL MEMORIAL MUSEUM	0	0	0.08	0.33		0	0.5	0.5	0	No			0	1	0.15	0.25	0	0.143	0
MUZIUM PERHUTANA N NEGERI PULAU PINANG	1	0	0.31	0.528		0.5	0	0	0	Yes	0	0	0.4	0.8	0.15	0.25	1	0.714	0.4
Gakeri Tuanku Ja'afar	0.5	1	0.5	0.33		0.5	0.5	0.5	1	Yes	0	0	1	0.55	0.7	0.75	1	0.571	0.4
Han Chin Pet Soo	0.5	0	0.08	0.66		1	0.5	0.5	1	No			0.1	0.55	0.15	0.5	0	0.286	0
Johor Bahru Chinese Heritage Musuem	0.5	0	0.08	0.726		0	0.5	0.5	1	No			1	0.7	0.15	0.75	1	0.286	0.2
THE ROYAL PRESS	0.5	1	0.28	0.528	using google sheet and	0	0.5	0	1	No			0.7	0.25	0.3	0.5	1	0.143	0.2

Table 4.9 continued

					google docs.														
Army Museum	0	1	0.8 4	0.66	Internet, facebook	0. 5	0. 5	0	0	No			0.6	0.8	0.15	0.7 5	1	0.42 9	0. 2
Bentong Gallery	0. 5	0	0.0 4	0.26 4		0. 5	0	0. 5	1	No			0.9	0.7 5	0.3	0.7 5	0. 8	0.28 6	0. 4
Royal Malaysia Police Museum	0	0	0.2	0.33		0	0. 5	0. 5	0	No			0	0	0.3	0.5	0	0	0
<i>Muzium Negeri Sembilan</i>	0. 5	1	0.0 8	0.79 2	None	0. 1	0. 5	0. 5	1	No			0.7	0.8	0.85	1	1	0.85 7	0. 8
<i>Muzium Rajo Istano Lamo Sari Mananti</i>	0. 5	1	0.0 8	0.79 2	None	0. 1	0. 5	0. 5	1	No			0.7	0.8	0.85	1	1	0.85 7	0. 8
<i>Muzium Rembau</i>	0. 5	1	0.0 8	0.79 2	None	0. 1	0. 5	0. 5	1	No			0.7	0.8	0.85	1	1	0.85 7	0. 8
<i>Teratak Zaaba</i>	0. 5	1	0.0 8	0.26 4	None	0. 1	0. 5	0. 5	1	No			0.7	0.8	0.85	1	1	0.85 7	0. 8
<i>Muzium Negeri Kedah</i>	0. 5	1	0.0 4	0.33		1	0. 5	0. 5	1	Yes	0	0	0.8	0.8	0.45	0	1	0.28 6	0. 4
<i>Muzium Nelayan Tanjung Balau, Johor</i>	0. 5	1	0.6 4	0.33		0. 5	0. 5	0. 5	1	Yes	0. 2	0	0.5	0.5 5	0.7	0.5	1	0.57 1	0. 6
Islamic Arts Museum Malaysia	0. 5	0	0.1 9	0.66	MUSIMs collection managemen t system	0. 1	0. 5	0. 5	1	Yes	0	0	1	1	0.45	0.7 5	1	0.85 7	0. 8

Table 4.9 continued

<i>Muzium Sultan Alam Shah</i>	0.5	1	0.49	0.99	padat integrated inventory system	0.1	0.5	0	1	Yes	0.2	0	0.2	1	0.85	0.5	1	0.286	0
<i>Muzium Gedung Raja Abdullah (Muzium Timah)</i>	0.5	1	0.49	0.99	padat integrated inventory system	0.1	0.5	0	1	Yes	0.2	0	0.2	1	0.85	0.5	1	0.286	0
<i>Muzium Insitu Jugra</i>	0.5	1	0.49	0.99	padat integrated inventory system	0.1	0.5	0	1	Yes	0.2	0	0.2	1	0.85	0.5	1	0.286	0
<i>Muzium Sabak Bernam</i>	0.5	1	0.49	0.99	padat integrated inventory system	0.1	0.5	0	1	Yes	0.2	0	0.2	1	0.85	0.5	1	0.286	0
<i>Muzium Sejarah Daerah Kuala Selangor</i>	0.5	1	0.49	0.99	padat integrated inventory system	0.1	0.5	0	1	Yes	0.2	0	0.2	1	0.85	0.5	1	0.286	0
<i>Galeri Arkeologi</i>	0	0	0	0.198		0.1	0	0	1	No			0.4	0.8	0.3	0.5	1	0.429	0.4
<i>Kompleks Muzium Diraja Sultan</i>	0.5	1	0.72	0.528		1	0.5	0.5	1	Yes	0	0.19	1	0.55	0.7	0.25	1	0.429	1

Table 4.9 continued

<i>Haji Ahmad Shah, Kuantan</i>																			
Museum of Asian Art	0	1	0.34	0.33		0.1	0.5	0	1	No			0	0.55	0.3	0.25	1	0.286	0.4
National Museum	0.5	0	0.72	0.528		1	0.5	0.5	1	Yes	0	0.19	0.9	0.75	0.85	0.5	1	0.429	0.4
Labuan Museum	0.5	1	0.35	0.33		0.5	0.5	0.5	0	No			0.6	0.25	0.4	0.75	0.8	0.143	0
Chimney Museum	0	0	0	0.33		0.1	0.5	0	0	No			0.4	0.25	0.15	0.1	1	0.143	0
<i>Sungai Lembing Museum</i>	1	1	0.4	0.396		1	0	0.5	0	Yes	0	0	0.2	0.8	0.15	0.25	0.8	0.286	0
<i>Muzium Istana Kesultanan Melaka</i>	0.5	0	0.32	0.33	-	0.1	0	0	1	Yes	0.3	0	1	0.75	0.7	1	1	0.571	0.6
<i>Muzium Sejarah dan Ethnografi</i>	0.5	0	0.32	0.33	-	0.1	0	0	1	Yes	0.3	0	1	0.75	0.7	1	1	0.571	0.6
<i>Muzium Pendidikan</i>	0.5	0	0.32	0.33	-	0.1	0	0	1	Yes	0.3	0	1	0.75	0.7	1	1	0.571	0.6
<i>Muzium Sastera Melaka</i>	0.5	0	0.32	0.33	-	0.1	0	0	1	Yes	0.3	0	1	0.75	0.7	1	1	0.571	0.6

Table 4.9 continued

<i>Galeri Laksamana Cheng Ho</i>	0.5	0	0.32	0.33	-	0.1	0	0	1	Yes	0.3	0	1	0.75	0.7	1	1	0.571	0.6
<i>Galeri Demang Abdul Ghani</i>	0.5	0	0.32	0.33	-	0.1	0	0	1	Yes	0.3	0	1	0.75	0.7	1	1	0.571	0.6
<i>Galeri Golf</i>	0.5	0	0.32	0.33	-	0.1	0	0	1	Yes	0.3	0	1	0.75	0.7	1	1	0.571	0.6
<i>Galeri Seni Rakyat</i>	0.5	0	0.32	0.33	-	0.1	0	0	1	Yes	0.3	0	1	0.75	0.7	1	1	0.571	0.6
<i>Balai Seni Lukis Melaka</i>	0.5	0	0.32	0.33	-	0.1	0	0	1	Yes	0.3	0	1	0.75	0.7	1	1	0.571	0.6
<i>Muzium TYT Yang Di-Pertua Negeri Melaka</i>	0.5	0	0.32	0.33	-	0.1	0	0	1	Yes	0.3	0	1	0.75	0.7	1	1	0.571	0.6
<i>Muzium Pemerintahan Demokrasi</i>	0.5	0	0.32	0.33	-	0.1	0	0	1	Yes	0.3	0	1	0.75	0.7	1	1	0.571	0.6
<i>Muzium Islam Melaka</i>	0.5	0	0.32	0.33	-	0.1	0	0	1	Yes	0.3	0	1	0.75	0.7	1	1	0.571	0.6
<i>Muzium Rakyat</i>	0.5	0	0.32	0.33	-	0.1	0	0	1	Yes	0.3	0	1	0.75	0.7	1	1	0.571	0.6
<i>Muzium Layang-Layang</i>	0.5	0	0.32	0.33	-	0.1	0	0	1	Yes	0.3	0	1	0.75	0.7	1	1	0.571	0.6
<i>Muzium Kecantikan</i>	0.5	0	0.32	0.33	-	0.1	0	0	1	Yes	0.3	0	1	0.75	0.7	1	1	0.571	0.6

Table 4.9 continued

<i>Muzium Belia Malaysia</i>	0.5	0	0.32	0.33	-	0.1	0	0	1	Yes	0.3	0	1	0.75	0.7	1	1	0.571	0.6
<i>Muzium Samudera Fasa I</i>	0.5	0	0.32	0.33	-	0.1	0	0	1	Yes	0.3	0	1	0.75	0.7	1	1	0.571	0.6
<i>Muzium Samudera Fasa II</i>	0.5	0	0.32	0.33	-	0.1	0	0	1	Yes	0.3	0	1	0.75	0.7	1	1	0.571	0.6
<i>Muzium Setem Melaka</i>	0.5	0	0.32	0.33	-	0.1	0	0	1	Yes	0.3	0	1	0.75	0.7	1	1	0.571	0.6
<i>Muzium Dunia Melayu Dunia Islam</i>	0.5	0	0.32	0.33	-	0.1	0	0	1	Yes	0.3	0	1	0.75	0.7	1	1	0.571	0.6
<i>Muzium Chetti</i>	0.5	0	0.32	0.33	-	0.1	0	0	1	Yes	0.3	0	1	0.75	0.7	1	1	0.571	0.6
<i>Muzium Pulau Besar</i>	0.5	0	0.32	0.33	-	0.1	0	0	1	Yes	0.3	0	1	0.75	0.7	1	1	0.571	0.6
<i>Muzium Kapal Selam</i>	0.5	0	0.32	0.33	-	0.1	0	0	1	Yes	0.3	0	1	0.75	0.7	1	1	0.571	0.6
<i>Muzium Hang Tuah</i>	0.5	0	0.32	0.33	-	0.1	0	0	1	Yes	0.3	0	1	0.75	0.7	1	1	0.571	0.6
<i>Muzium Orang Asli</i>	0.5	0	0.32	0.33	-	0.1	0	0	1	Yes	0.3	0	1	0.75	0.7	1	1	0.571	0.6
<i>Muzium Adat Istiadat</i>	0.5	0	0.32	0.33	-	0.1	0	0	1	Yes	0.3	0	1	0.75	0.7	1	1	0.571	0.6

Table 4.9 continued

<i>Muzium Sejarah Warisan Nanning Dan</i>	0.5	0	0.3 2	0.33	-	0.1	0	0	1	Yes	0.3	0	1	0.75	0.7	1	1	0.571	0.6
<i>Muzium Tentera Laut Diraja Malaysia (TLDM)</i>	0.5	0	0.3 2	0.33	-	0.1	0	0	1	Yes	0.3	0	1	0.75	0.7	1	1	0.571	0.6
<i>Malaysia Prison Museum</i>	0.5	1	0.2 1	0.33		0.5	0.5	0.5	0	Yes	0	0	0.5	0.55	0.55	0.5	1	0.429	0
<i>Muzium Adat/Custom Museum</i>	0.5	1	0	0.26 4		1	0.5	0.5	0	No			0.2	0.55	0.4	0.7 5	0.8	0	0
<i>Muzium Petroleum Miri</i>	0	0	0.4	0.26 4		0.1	0	0.5	1	No			0.6	0.75	0	0.7 5	0.8	0.429	0.4
<i>Muzium Arkeologi Niah</i>	0	0	0.4	0.26 4		0.1	0	0.5	1	No			0.6	0.75	0	0.7 5	0.8	0.429	0.4
<i>Muzium Wilayah Limbang</i>	0	0	0.4	0.26 4		0.1	0	0.5	1	No			0.6	0.75	0	0.7 5	0.8	0.429	0.4

Table 4.9 continued

<i>Muzium Wilayah Baram</i>	0	0	0.4	0.264		0.1	0	0.5	1	No			0.6	0.75	0	0.75	0.8	0.429	0.4
<i>Balai Seni Lukis Sabah</i>	0.5	0	0.5	0.33		0.1	0	0	1	Yes	0.2	0	0.1	0.55	0.7	0.25	0.8	0	0.2
<i>Muzium Geologi</i>	0.5	1	0	0.33		0.5	0	0.5	1	No			0.3	0	0	0.25	0	0	0
<i>Marine Museum Labuan</i>	0.5	0	0.19	0.33		0.1	0.5	0.5	0	No			0	0.8	0.4	0.5	0.8	0.571	0
<i>Muzium Seni Kraf Orang Asli</i>	0.5	1	0.7	0.726	MUSECOR E System	1	0.5	0.5	1	Yes	0	0	0.6	0.8	0.85	0.5	1	0.429	0.6
<i>Muzium Etnologi Dunia Melayu</i>	0.5	1	0.7	0.726	MUSECOR E System	1	0.5	0.5	1	Yes	0	0	0.6	0.8	0.85	0.5	1	0.429	0.6
<i>Muzium Tekstil Negara</i>	0.5	1	0.7	0.726	MUSECOR E System	1	0.5	0.5	1	Yes	0	0	0.6	0.8	0.85	0.5	1	0.429	0.6

Table 4.9 continued

<i>Muzium DiRaja</i>	0.5	1	0.7	0.726	MUSECORE System	1	0.5	0.5	1	Yes	0	0	0.6	0.8	0.85	0.5	1	0.429	0.6
<i>Muzium Kota Kayangan</i>	0.5	1	0.7	0.726	MUSECORE System	1	0.5	0.5	1	Yes	0	0	0.6	0.8	0.85	0.5	1	0.429	0.6
<i>Muzium Arkeologi Lembah Bujang</i>	0.5	1	0.7	0.726	MUSECORE System	1	0.5	0.5	1	Yes	0	0	0.6	0.8	0.85	0.5	1	0.429	0.6
<i>Muzium Kota Kuala Kedah</i>	0.5	1	0.7	0.726	MUSECORE System	1	0.5	0.5	1	Yes	0	0	0.6	0.8	0.85	0.5	1	0.429	0.6
<i>Galeria Perdana</i>	0.5	1	0.7	0.726	MUSECORE System	1	0.5	0.5	1	Yes	0	0	0.6	0.8	0.85	0.5	1	0.429	0.6
<i>Muzium Perak</i>	0.5	1	0.7	0.726	MUSECORE System	1	0.5	0.5	1	Yes	0	0	0.6	0.8	0.85	0.5	1	0.429	0.6
<i>Muzium Matang</i>	0.5	1	0.7	0.726	MUSECORE System	1	0.5	0.5	1	Yes	0	0	0.6	0.8	0.85	0.5	1	0.429	0.6
<i>Muzium Automobil Nasional</i>	0.5	1	0.7	0.726	MUSECORE System	1	0.5	0.5	1	Yes	0	0	0.6	0.8	0.85	0.5	1	0.429	0.6
<i>Muzium Lukut</i>	0.5	1	0.7	0.726	MUSECORE System	1	0.5	0.5	1	Yes	0	0	0.6	0.8	0.85	0.5	1	0.429	0.6
<i>Muzium Seni Bina Malaysia</i>	0.5	1	0.7	0.726	MUSECORE System	1	0.5	0.5	1	Yes	0	0	0.6	0.8	0.85	0.5	1	0.429	0.6

Table 4.9 continued

<i>Muzium Kota Johor Lama</i>	0.5	1	0.7	0.72 6	MUSECO RE System	1	0.5	0.5	1	Yes	0	0	0.6	0.8	0.85	0.5	1	0.429	0.6
Fort Lily, Betong	0.5	1	0.2 8	0.52 8	Sarawak Museum Collection Managem ent System	1	0.5	0.5	1	Yes	0.2	0	1	0.55	0.3	1	1	1	1
Fort Emma, Kanowit	0.5	1	0.2 8	0.52 8	Sarawak Museum Collection Managem ent System	1	0.5	0.5	1	Yes	0.2	0	1	0.55	0.3	1	1	1	1
Fort Brooke, Julan	0.5	1	0.2 8	0.52 8	Sarawak Museum Collection Managem ent System	1	0.5	0.5	1	Yes	0.2	0	1	0.55	0.3	1	1	1	1
<i>Muzium Budaya Borneo</i>	0.5	0	0.1 8	0.72 6		1	0.5	0.5	1	Yes	0.2	0.19	0.4	0.55	0.3	1	0. 8	0.714	0.6
<i>Muzium Sarawak</i>	0.5	0	0.1 8	0.72 6		1	0.5	0.5	1	Yes	0.2	0.19	0.4	0.55	0.3	1	0. 8	0.714	0.6
<i>Muzium Sejarah Cina</i>	0.5	0	0.1 8	0.72 6		1	0.5	0.5	1	Yes	0.2	0.19	0.4	0.55	0.3	1	0. 8	0.714	0.6
<i>Muzium Warisan Islam</i>	0.5	0	0.1 8	0.72 6		1	0.5	0.5	1	Yes	0.2	0.19	0.4	0.55	0.3	1	0. 8	0.714	0.6

Table 4.9 continued

<i>Muzium Semulajadi</i>	0.5	0	0.18	0.72 6		1	0. 5	0. 5	1	Yes	0.2	0.1 9	0.4	0.5 5	0.3	1	0. 8	0.71 4	0. 6
<i>Muzium Seni Sarawak</i>	0.5	0	0.18	0.72 6		1	0. 5	0. 5	1	Yes	0.2	0.1 9	0.4	0.5 5	0.3	1	0. 8	0.71 4	0. 6
<i>Muzium Tekstil Sarawak</i>	0.5	0	0.18	0.72 6		1	0. 5	0. 5	1	Yes	0.2	0.1 9	0.4	0.5 5	0.3	1	0. 8	0.71 4	0. 6
<i>Muzium Warisan Sri Aman, Kubu Alice</i>	0.5	0	0.18	0.72 6		1	0. 5	0. 5	1	Yes	0.2	0.1 9	0.4	0.5 5	0.3	1	0. 8	0.71 4	0. 6
<i>Rumah Sri Aman Galeri</i>	0.5	0	0.18	0.72 6		1	0. 5	0. 5	1	Yes	0.2	0.1 9	0.4	0.5 5	0.3	1	0. 8	0.71 4	0. 6

4.4.2 The Digital Readiness Index (DRI)

The equation to calculate the digital readiness index, $DRI = \sum_{i=1}^5 w_i * \left(\sum_{j=1}^n w_j * \left(\sum_{k=1}^m w_k * Q_k \right) \right)$ is applied to calculate the museums' digital readiness index. Appendix E shows the score of each dimension of the museums and the Digital readiness index. Based on Appendix E, the highest score of the People dimension is 1, which is the *Sungai Lembing* Museum. The second highest score of the dimension is 0.7/1, where there are a total of 38 museums. 2 museums scored 0.6/ 1, 3 museums scored 0.4/1, 47 museums scored 0.3/1 and 9 museums scored 0/1 for the People dimension. Figure 2.26 shows the pie chart of the people dimension scores of the 100 museums.

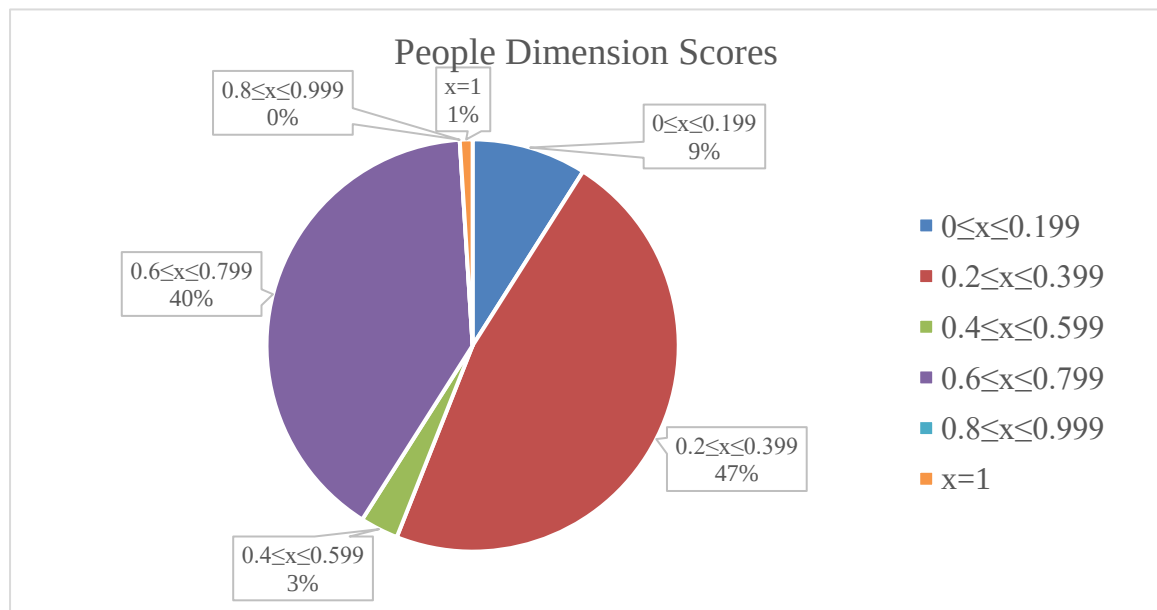


Figure 4.26: The People Dimension Score

As for the technology dimension, the top three highest scores are 0.825/1, 0.794/1 and 0.672/1. Table 4.10 shows the list of museums that scored the top three highest scores in the technology dimension. The museum that achieved the lowest is *Muzium Perhutanan*

Negeri Kedah. Figure 4.27 depicts the technology dimension scores of museums, where the range score that have highest number of museums is $0.4 \leq x \leq 0.599$.

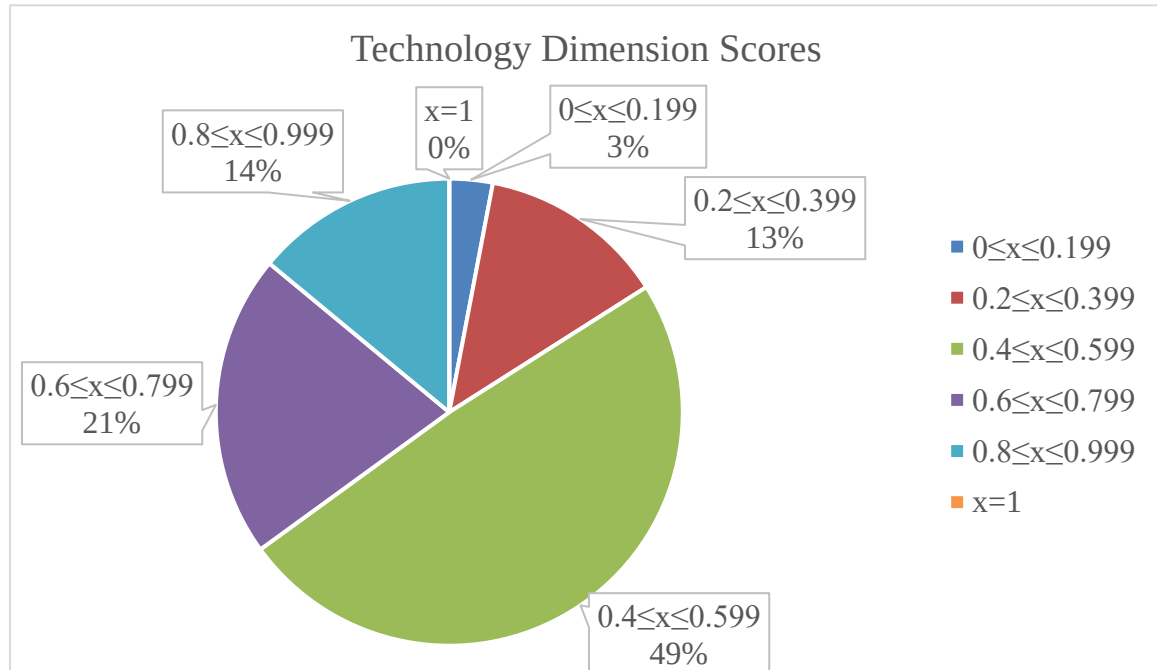


Figure 4.27: The Technolgy Dimension Scores

As for process dimension, the top three scores are 1/1, 0.9/1, and 0.7/1. According to Appendix E, the Johor Bahru Chinese Heritage Museum has the highest score(1/1), Bentong Gallery has the second highest score (0.9/1) followed by a total of 5 museums have the same scores which are The Royal Press, *Muzium Negeri Sembilan*, *Muzium Rajo Istano Lamo Sari Menanti*, and *Teratak Zaaba*, with the score of 0.7/ 1. The museums with the third highest score in the process dimension are the Army Museum and the Labuan Museum. These museums only have back-office process. As for the museums with both front-office process and back-office process, the highest score for their process dimension is 0.59/1, which are the museums under the management of *PERZIM*. Figure 4.28 shows the pie chart of the process dimension scores of museums in Malaysia.

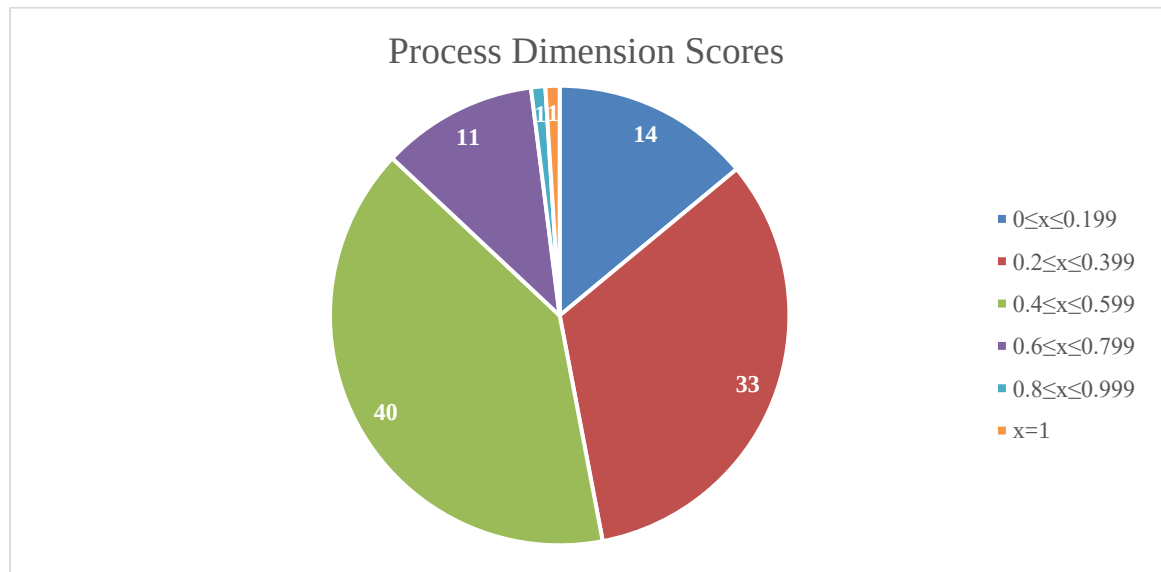


Figure 4.28: The Process Dimension Scores

For the customer dimension, the top three scores are 0.875/1, 0.809/1 and 0.776/1. Museums that score 0.875/1 for this dimension are *Muzium Negeri Sembilan*, *Muzium Rajo Istano Lamo Sari Menanti*, and *Teratak Zaaba*. Museums with the second highest score are the 28 museums that are under the management of PERZIM, while the third highest score is the museums under the PADAT Management, which are *Muzium Sultan Alam Shah*, *Muzium Gedung Raja Abdullah (Muzium Timah)*, *Muzium Insitu Jugra*, *Muzium Sabak Bernam*, and *Muzium Sejarah Daerah Kuala Selangor*. The lowest score of the customer is 0.083/1 which is *Muzium Geologi*. Figure 4.29 shows the customer dimension scores of the museums.

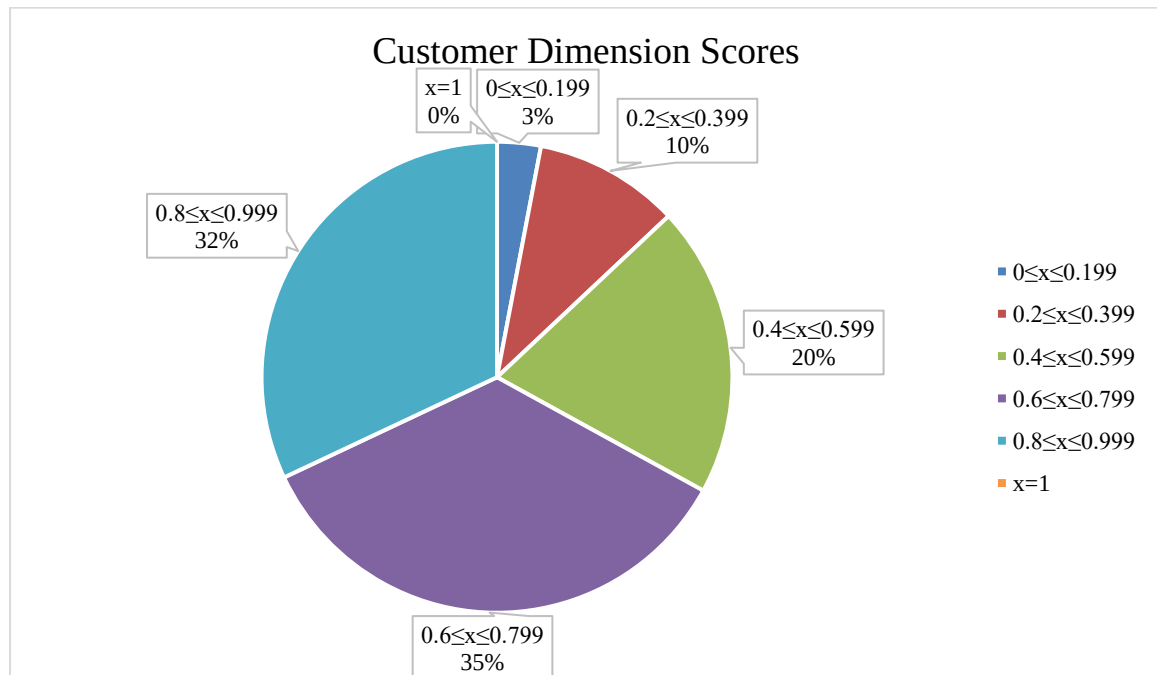


Figure 4.29: The Customer Dimension Scores of Museums

For the last dimension, Strategy and Investment, the top three scores are 0.969/1, 0.888/1 and 0.844/1. The museums with the highest scores (0.969/1) are Fort Lily, Fort Emma and Fort Brooke. The central regional office of the Sarawak Museum department manages these three museums. The museums that score the second highest are Islamic Arts Museum Malaysia, along with the museums that are managed by the Lembaga Muzium Negeri Sembilan, which are *Muzium Negeri Sembilan*, *Muzium Rajo Istano Lamo Sari Mananti*, *Muzium Rembau* and *Teratak Zaaba*. The third highest score is *Kompleks Muzium Diraja Haji Ahmad Shah*. The museum that scored the lowest is the Royal Malaysian Police Museum (0/1). Figure 4.30 shows the last dimension score of the local museums.

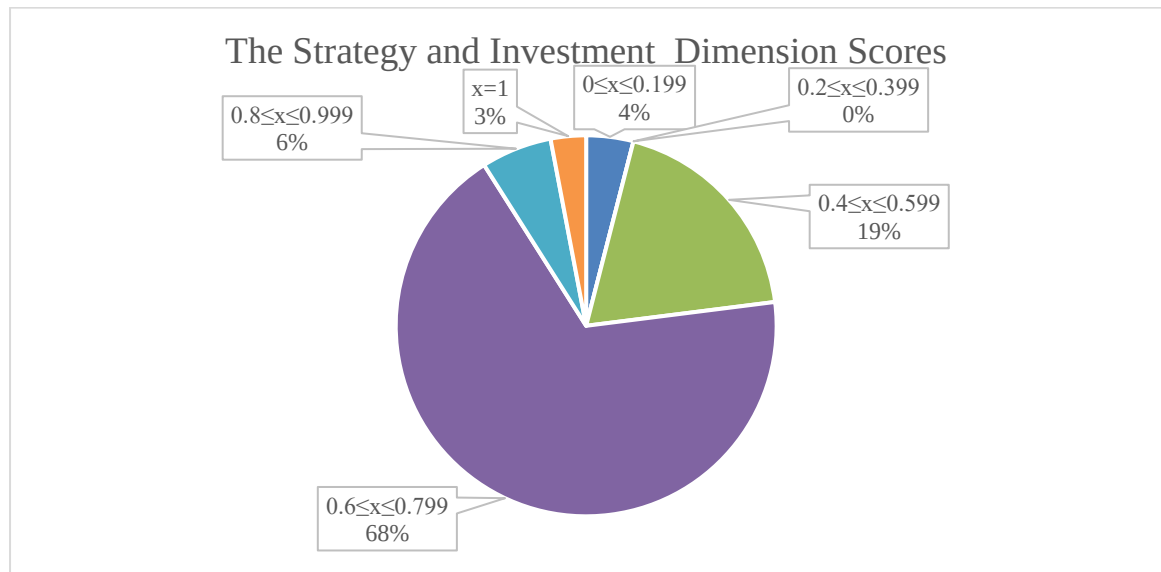


Figure 4.30: The Strategy and Investment Dimension Scores of Museums

After the dimension scores of all museums are calculated, the DRI scores of the participated museums were calculated. The highest score is 0.76/ 1, which the museums under the *Lembaga Muzium Negeri Sembilan* score. This depicts that these museums can pursue a long-term digital strategy while investing their resources in projects for digital transformation. The second highest score is 0.733/1, which are the museums under the management of the Central Regional Office of Sarawak Museum Department. The third highest is the museums under the management of *Kompleks Muzium Diraja Haji Ahmad Shah*, with a score of 0.705. As for the average DRI of Malaysian Museums, the score is 0.565/1. Based on the scores, the authors have divided them into 6 range scores, namely $0 \leq x \leq 0.199$, $0.2 \leq x \leq 0.399$, $0.4 \leq x \leq 0.599$, $0.6 \leq x \leq 0.799$, $0.8 \leq x \leq 0.999$, and $x=1$. Among the range scores, the range score that have the most number of museums are $0.6 \leq x \leq 0.799$ with the total of 59 museums. This depicts the museums are aware of digital transformations and have make efforts in achieving this transformation. Figure 4. 31 depicts the pie chart of the DRI scores of museums in Malaysia.

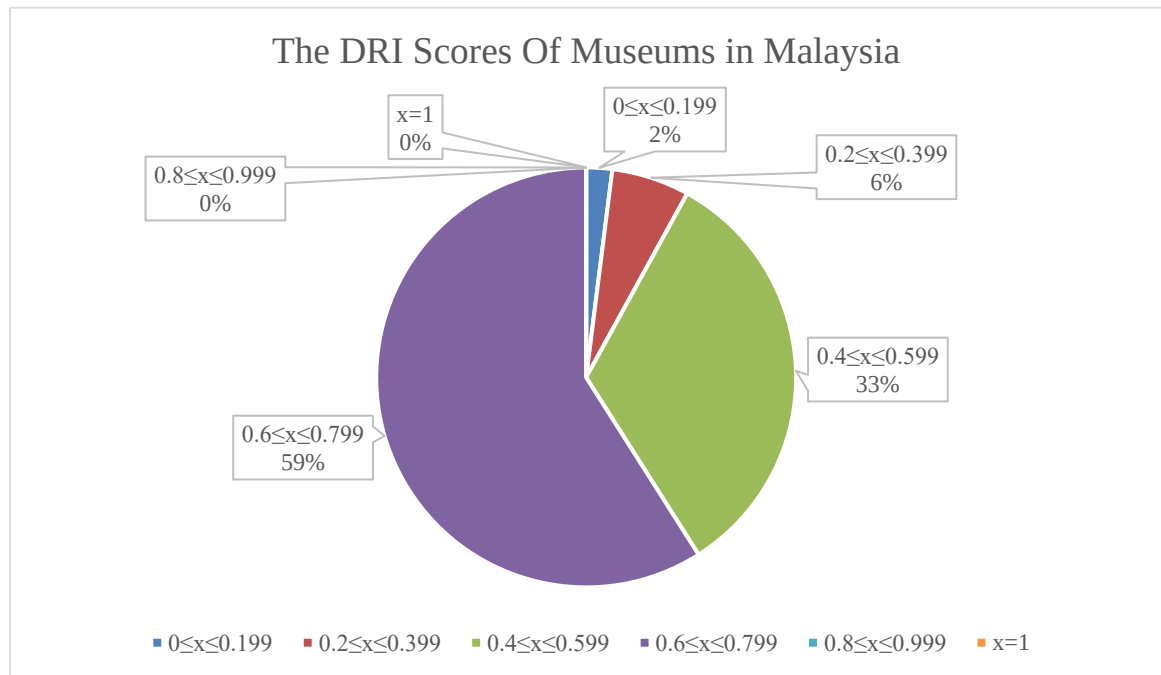


Figure 4.31: The DRI Scores Of Museums in Malaysia

Figure 4.32 shows the graph of the average score of all five dimensions of the Malaysian museums. As for the average score of each dimension for the museums in Malaysia, the highest score is the strategy and investment dimension (0.679/1), followed by the customer (0.643/1), technology (0.512/1), people dimension (0.441/1), and process (0.42/1). This depicts that most participate museums are aware of digital transformation and have make effort in strategies and invest in museum projects relate to digital transformation, but lack in people dimension and process dimension.

Table 4.9: The list of museums with the top three highest scores in the technology dimension.

Museums that score 0.825/1	Museums that score 0.794/1	Museums that score 0.672/1
<i>Muzium Seni Kraf Orang Asli</i>	<i>Kompleks Muzium Diraja Sultan Haji Ahmad Shah</i>	<i>Muzium Nelayan Tanjung Balau, Johor</i>
<i>Muzium Etnologi Dunia Melayu</i>	<i>National Museum</i>	
<i>Muzium Tekstil Negara</i>		
<i>Muzium DiRaja</i>		
<i>Muzium Kota Kayangan</i>		
<i>Muzium Arkeologi Lembah Bujang</i>		
<i>Muzium Kota Kuala Kedah</i>		
<i>Galeria Perdana</i>		
<i>Muzium Perak</i>		
<i>Muzium Matang</i>		

Table 4.10 continued

<i>Muzium Automobil Nasional</i>		
<i>Muzium Lukut</i>		
<i>Muzium Seni Bina Malaysia</i>		
<i>Muzium Kota Johor Lama</i>		

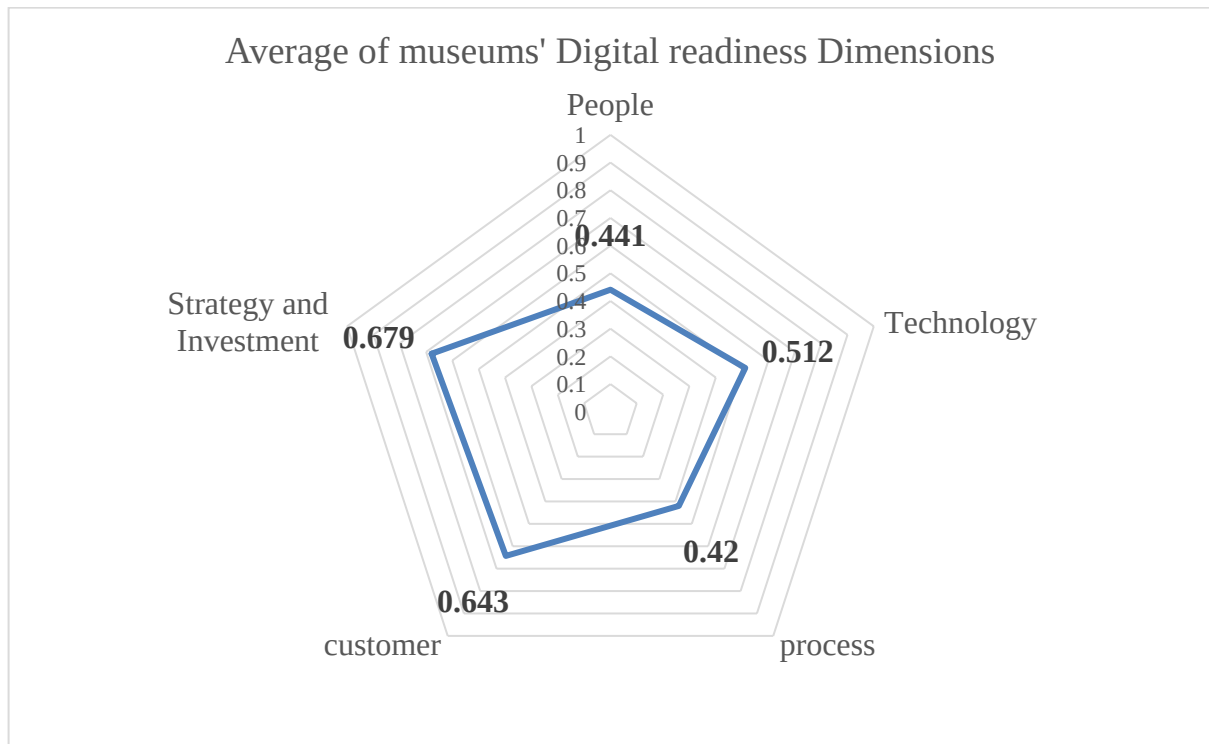


Figure 4.32: The average of the Malaysian Museums' Digital Readiness Dimensions.

4.5 Discussion

This section is used to discuss the two research questions of this study. The author divided this section into 2 sections in terms of the two research questions (RQ).

RQ1: How to evaluate digital readiness of museums in Malaysia?

To answer this research questions, the researcher found that there are few types of validations to validate questionnaire, namely face validity, content validity, construct discriminant validity, construct convergent validity, criterion predictive validity, criterion concurrent validity, criterion postdictive validity and reliability internal consistency (Taherdoost, 2016). According to Taherdoost (2016), the content validity is highly recommended to test the validity of the questionnaire. Aside from that, Yusoff (2019) shared the content validity acts as an important evidence to support the validity of the questionnaire (measuring tool) for the research. Thus, the author adopted content validity to validate the

suitability of the adopted DRQ to measure the digital readiness of museums in Malaysia before collecting the DRI of museums in Malaysia.

As mentioned in Chapter 4.2.2, Q4 was removed as the CVI of this question in all three content validation did not pass 0.8. The question asked whether the museums have the digitised version of the museums' artefacts. Museum collections are digitised in terms of 2D and 3D forms. As mentioned by Abd Manaf (2007), 17 % of the museum artefacts were digitised among the 60 museums that have answered Abd Manaf's survey. This digitisation started way before the pandemic and was accelerated during the pandemic, which shows that the percentage of digitised artefacts may increase. In addition, the digitization of collections can be represented in technology presence as well as digital archives under technology dimension, where artefacts are digitized in 2D images and 3D versions of the artefacts to when adopting the listed technologies in Q3 and catalogued in the museum database or software. For example, interactive display is one of the technologies presented in museums. It includes digitising artefacts in 2D or 3D to allow the user to interact with the artefacts digitally.

Based on the conceptual relationship of digitization and digitalization framework proposed by Gradillas & Thomas (2023), digital technologies are under the digitalization of digital artefacts for socio-economic transformation. This supports the idea that 'technology presence' includes digitization of the collection. Apart from that, the question 'Is there a digitalized version of the museums' artefacts?' is not specific enough about whether the digitized collection refers to 2D versions or 3D versions of the artefacts. For example, digitising natural history collections involves the emergence of 2D and 3D images, converting transcripts to digital, image segment analysis, and studies of biochemical, molecular and genetic (Ong et al., 2023). The digitisation of collections is not a new initiative

for Malaysian Museums (Abd Manaf, 2007), which means most of the museum collections have a digitized version in the form of images. As the questions in DRQ is to get a general idea of the digital readiness of museums in achieving digital transformation, the author decided not to include the Q4 and suggested that the topic on digitisation of museum artefacts can be highlighted on next future research study in developing a museum management system.

Apart from that, the types of collection methods being catalogued are reduced from 4 to 3. The methods, namely, the cataloguing is handled through proprietary software and ‘The cataloguing is handled through an ICDD or region proprietary information system’ were simplified into ‘The cataloguing is handled through other software’ after discussion with the museum experts during CV I. This is because not many museums in Malaysia have a specific system or software for cataloguing their collection. The collected data supports the statement, showing that 56% of the museums do not adopt other software to catalogue their collections.

Therefore, the adopted DRQ was validated for the next phase of the research to answer RQ2. Aside from that, the adapted DRQ can be used as a guide or a startup to understand the current state of the museums before developing any application systems or proposing a museum project for digital transformation. This can help museum achieve sustainability.

RQ2: What is the digital readiness index score of museums in Malaysia?

To answer this research question, the author collected the digital readiness index of museums in Malaysia using the adapted questionnaire in the first phase. The DRI of museums in Malaysia allows researcher to learn about the current readiness of museums in

Malaysia. Based on the analysed data (Appendix E), the average DRI score of Malaysian Museums is 0.57/1, which shows that the museums in Malaysia are not fully digitalized yet and still have space for improvement to achieve digital transformation. The DRI scores can acts as a retrospective perspective for researcher or museum manager to view which dimension of digital transformation needs more effort.

For people dimension, there are 56 % of the museums that scored less than 0.4, which shows some museums does not have the museum staff that are specialised in IT or specific IT position in handling the digital activities in museums. It supported the problems mentioned in Chapter 1.2 on the lack of human resources and technical skills. This can also be supported by the occupation of the participants that responded to the DRQ. As the researcher requested the museum departments to appoint their museum managers to answer the DRQ, there were different types of occupations listed by participants. This dimension enables museums to view the needs to employ the listed occupations depending on the need of the museums. Like digital data are hard to maintain and preserve due to the evolving of technologies (Abd Rahman et al., 2023), the human resources and technical skill need to maintain in handling the evolving technologies adopted in the museums.

For technology dimension, the DRI results enable researcher to know the types of digital technologies that are presence in the museums and what are the technologies the museum would like to adopt, what are the types of catalogues used to catalogue their collections, the management of visitors' data, social network channels data, and online review data as well as the Wi-Fi Connection in museums. Based on the findings in Chapter 4.3.2.1 ii., the researcher can concluded that museums in Malaysia still need some improvements as not many museums are like *Kompleks Muzium Diraja Sultan Haji Ahmad Shah* which adopt 7 out of 8 listed technologies. This dimension enable researcher to focus

on museums that want to adopt listed technologies in Q3 and propose the a suitable of technologies for museums. In addition, the data collected in the Q9, majority of the museums have Wi-Fi connections (89%) which had solve one of the challenges in findings of Fauzi and co-researchers (2022), infrastructure for connectivity. With Wi-Fi connections, museums can adopt emerging technologies like augmented reality mobile application for visitor to use while visiting the museum.

Apart from that, the process dimension has the lowest average score compared to other dimensions, which means there is a need to improve the museum's process either in the front office or in the back office. The collected data shows that 30% of the 100 museums do not have ticketing systems. Aside from that, the highest number of museums that use these kind of ticketing service among the 70 museums with ticketing systems are paper bills and paper accounting. However, the least number of museums (30) applied more than one kind of ticketing system, where 1 museum adopted paper bill and paper accounting as well as paper bill and digitalized invoice, while 29 museums adopted paper bill and paper accounting along with e-ticket printable at home. During the pandemic, there was an increasing number of museums adopting e-ticketing systems or online ticket booking, as it allows museums to restrict the number of visitors to visit the museum for safety measures such as Louvre Museum and National Museum of China (Tan et al., 2021). E-tickets on mobile can allow museums to reduce the cost of traditional paper-based ticket production and encourage visitors to purchase tickets easily (Patil et al.,2018). On top of that, Rathore and co-researchers (2022) also shared that providing an electronic ticketing system in museums not only reduces the use of paper tickets and proposed their ticketing systems that include QR codes along with a biometric scanner to verify visitors' identity and validation of ticket. This enables museums to improve the ticket booking process and revolutionize

museum attendance. The collected data shows the number of museums in Malaysia that adopted e-tickets is less, which allows future researchers as well as museum managements to find the types of challenges faced by the local museums that prevent them from adopting e-ticketing and the type of ticketing systems that are suitable for various museum users' conditions. The researcher also suggests that the e-ticketing system can add gamification; visitors can collect points or virtual tokens after purchasing e-tickets, and the use of the rewards can be converted to discount vouchers on the next visits.

For customer dimension along with strategy and investment dimension, it depicts that most museum focus more on these two dimensions in terms of process dimension and people dimension. Most museum have use social medias as well as websites to promote. However, museums that perform marketing activities through newsletter, online/ social network advertising, websites and social media may not help in increasing the number of visitors. Based on the analysis of author, there are 8 museums that use all 4 marketing activities and compared it with the amount of visitors stated by the participants, there 2 group of museums, where are 'own all 4 marketing activities and have greater number of museum visitors'(e.g. STIDC Timber Museum) and 'own all 4 marketing activities but have low number of visitors' (e.g. Islamic Arts Museum Malaysia). These supports the statement of SER (2020) where museums with low visitor count should focus on what type of marketing strategies can help museum to gain more visitors instead of focusing on the promotional tools.

Even though the strategy and investment dimension scores of museums is higher compared to other dimensions, the greatest number of museums that they invest in digital innovation is in the range of 26% to 50 % (53 museums). This may result in limited fundings for availability of equipment (Ong et al., 2023) and difficulty in improving museum's managements(Abd Manaf, 2007).

Aside from that, the museums' dimensions and DRI score enable researchers and museum management to learn about the digital readiness of the museum(s) and to view which dimension needs more effort to achieve digital transformation. The questionnaire acts as an assessment to learn how ready the museums are to undergo digital transformation. Based on the collected data, some Malaysian Museums show that they have put effort into adopting digital technologies for each dimension of digital transformation. For example, the museums under the management of Sarawak department where the DRI score are Fort Lily, Fort Emma, and Fort Brooke, which are under the management of the central regional office of the Sarawak Museum Department (0.742/1). Compared to other regional offices of the Sarawak Museum Department, the museums under the management of the central regional office stand out in the People, Process, Strategy, and Investment dimensions (Figure 4.33). The DRI scores can also compare with the number of visitors visited the museums. Based on the demographic data, the central regional office have the highest number of visitors (above 1 million visitors) compared to Southern Regional Office (400,000 visitors) and Northern Regional Office (2500 visitors). Thus, the museum management can focus on the process and customer dimensions as the score is lower among the dimensions. The Southern Office needs to focus more on the people dimension and the Process dimension, while the Northern Regional Office needs to focus more on the people dimension, technology dimension, process dimension, and strategy and investment dimension.

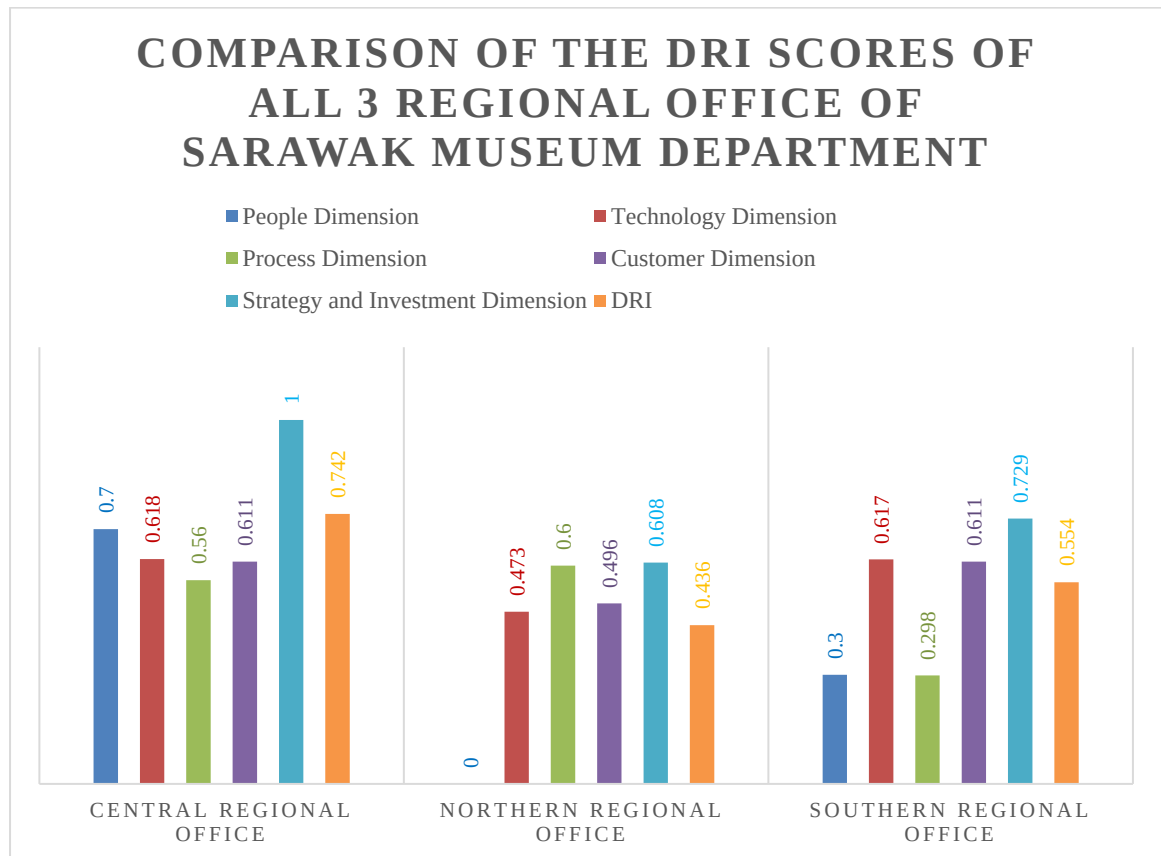


Figure 4.33: The Comparison of the DRI scores of all 3 regional office of Sarawak Museum Department.

4.6 Chapter Summary

This chapter has provided the result of the CVI, the finalized DRQ, the score of the questions of DRQ, and the DRI score of the museums. The discussion of the research is explained in this chapter as well.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Museums have undergone digitization and digitalisation to stay relevant in this digital era. With these two processes, it led to digital transformation. However, there are articles that shared the issues and challenges faced by the museums when undergo digitisation and digitalisation. As mentioned in chapter 1, the issues and challenges were technical and infrastructure issues (Abd Manaf, 2007; Fauzi et al., 2022; Ong et al., 2023; Abd Rahman et al., 2023), lack of human resources and skills (Abd Manaf, 2007; Fauzi et al., 2022; Ong et al., 2023; Abd Rahman et al., 2023), financial issues (Abd Manaf, 2007; Fauzi et al., 2022), as well as issues in museum collections management (Abd Manaf, 2007; Fauzi et al., 2022; Ong et al., 2023; Abd Rahman et al., 2023). Parviainen et al. (2022) stated that the digital transformation model can handle the company's digitisation changes.

In the journey of digital transformation proposed by Aras & Büyüközkan (2023), there are few stages required, which are awareness, readiness, planning and executions. The readiness stage consists of the digital maturity model and assessment before planning the digital transformation roadmap of the organization. According to Fauzi et al. (2022), growing technologies should be used wisely to benefit the museum sector and other future industries' continuity and relevance. Thus, they suggested that an in-depth study should be conducted to assess the digital readiness of Malaysian museums. The adopted DRQ was localized using content validity and distributed to museums in Malaysia. Based on the collected data, the DRI score and the score of each dimension was calculated and analysed,

enabling the author to picture the readiness of museums to achieve digital transformation and proposing sustainable approach when adopting digital technologies.

The findings depict the average DRI scores of museums in Malaysia is 0.57, which shows the museums are aware of the benefits of digital technologies and has put effort in achieving digital transformation. The questionnaire acts as a guide or an assessment for museum managers to acknowledge the museums' performance in adopting digital technologies in all five dimensions and prevent museums from being outdated. Therefore, the adapted DRQ act as a retrospective assessment tool to determine the readiness of museum to achieve digital transformation, where researcher can see which dimension of the museums needs more effort to stay on the track to achieve digital transformation. In addition, these dimensions supported the problems shared by past local museum articles such as the lack of human resources and skills (Abd Manaf, 2007; Fauzi et al., 2022; Ong et al., 2023; Abd Rahman et al., 2023), limited fundings for availability of equipment (Ong et al., 2023) and difficulty in improving museum's managements (limited fundings for availability of equipment (Ong et al., 2023) and difficulty in improving museum's managements (SER, 2020). From the result in customer dimension, it shows museums with low visitor count should focus on what type of marketing strategies can help museum to gain more visitors instead of focusing on the promotional tools. This proof that the DRQ acts a tools for researchers or museums to understand the current state of the museum and venture into the dimension that need to improve to achieve digital transformation.

5.2 Recommendations

In the research the adapted DRQ is suggested to use as a tool to determine the digital readiness of the current museums before venturing into the development of new strategies

or plan in digital innovation to stay sustainable. The findings of the study also allow researchers to determine the challenges faced by museums and scale down to the dimensions that need to be improved. For example, the museum in Malaysia need to focus on the process dimension and people dimension as both average dimension score is lower compared to the other dimension. Museums can deep dive into the listed 10 activities in the process dimension, which activities do not have informative support and what are the reason of these limitation. Is there a need for the museums to adopt informative system for that particular activity. If there is a need for the adoption, what is the budget museums for adopting the informative system and which type of informative system is better in terms of the cost, maintenance and the skills needed in handing the informative system.

As the questionnaire mainly focuses on the museum management in handling the adoption of digital technologies in all five dimensions, the researchers urge future local researchers who have an interest in venturing into the development of emerging technology for the museums to adopt the DRI questionnaire as well as the visitors' impression questionnaire (Gamal et al., 2023) to get the picture of the current situation of the museums in terms of the managements' perspective and museums visitors perspective before proposing a framework in designing and developing a user-friendly and management-friendly museum system or applications. Future researchers and IT sector can adopt museum management factors questionnaires (Kumraksa & Monpanthong, 2024) with the DRQ to learn about the current state of the museums before developing the types of systems or application for museums. Aside from that, future researchers can refer to the types of museums that would like to adopt the listed digital technologies from Q3 of the DRQ, where the researchers can select the digital technology that the museum would like to adopt and

venture into the types of sustainable digital initiatives that can help the museums in attracting visitors to visit the museums.

In addition, future researchers or IT industries can collaborate with the museums depending on the types of digital projects that are related to the dimensions that need to be focused on in the museum, for example, proposing e-ticketing systems where museum visitors can book e-tickets for future visits without queuing at the entrance and collect the Museum tickets. They can show their e-tickets from their phone without printing the tickets, making it user-friendly and eco-friendly. The management, on the other hand, can keep track of the number of visitors, the visitors' information, the time most visitors visit, and the number of repeated museum visits. This enables the museum to decide the suitable time for temporary exhibitions or propose new immersive technologies to exhibit certain artefacts and interactive storylines.

On top of that, the design and development of the intelligent system for a museum in managing visitors, technologies adopted by museums, museums activities, digitised collections and museum management is suggest to help improve the museums operations. Apart from that, the author also designs a conceptual framework, where the digital transformation framework involves the knowledge of the current state of the museums, the strategies of the museums in terms of the five dimensions and the executions of digital innovations (Figure 5.1). this framework will be future discuss in the future research regarding the digital transformation of museums.

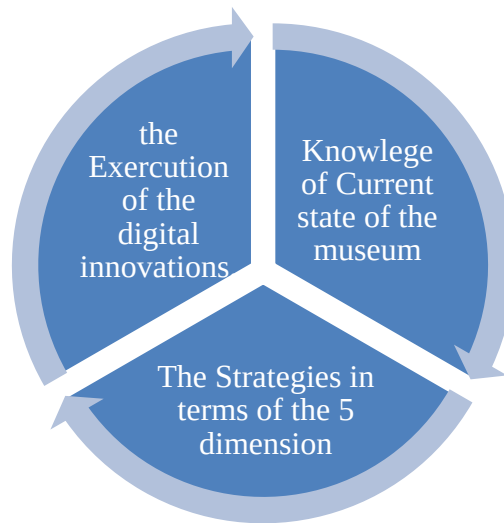


Figure 5.1: The Theoretical Digital Transformation Framework.

5.3 Limitation

This study faces three main limitations. First, the sample size of 100 museums, while comprehensive for Malaysia, may not fully capture the diversity and specific challenges faced by smaller or more specialized museums, potentially limiting the generalizability of the findings. Second, the reliance on self-reported data through the Digital Readiness Questionnaire (DRQ) may introduce bias, as respondents might overestimate their digital readiness or capabilities. Third, the cross-sectional nature of the study provides a snapshot of digital readiness at a specific point in time, without accounting for the dynamic and evolving nature of digital transformation efforts, which may change rapidly in response to technological advancements (e.g. Artificial Intelligence) and external factors such as funding availability and policy changes.

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APPENDICES

Appendix A: The adopted Digital Readiness Questionnaire.

Dimension (w_i)	Sub-dimension (w_j)	Metric (w_k)	Question (Q_k)	
People (0.2)	Digital skills (1)	Specialized personnel (0.6)	1. In your institution, are there employees specialized in digital transformation?	No (0)
				Yes, some people are in charge of managing digital activities, even if there is not a specialized team(0.5)
				Yes, external consultants(0.5)
				Yes, we rely on a specialized team of X people (1)
		Access to Digital Skills (0.4)	2. In your institution, is it present any of these positions?	Digital Responsible(1)
				Social Media Manager(1)
				Digital Curator(1)

Appendix A continued

				Digital User Experience developer(1)
				Data Protection Officer (1)
				Others(1)
Technology (0.2)	Technology adoption(0.4)	Technology presence (0.5)	1.Which one of these technologies is present in your museum?	Audioguide (0.02)
				We would like to include audioguide (0.01)
				We had audioguide but decided to remove it (0.01)
				Augmented Reality (0.2)
				We would like to include Augmented Reality (0.1)
				We had Augmented Reality but decided to remove it (0.1)
				Virtual Reality (0.2)
				We would like to include Virtual Reality (0.1)

Appendix A continued

				We had Virtual Reality but decided to remove it (0.1)
				QR Code (0.08)
				We would like to include QR Code (0.04)
				We had QR Code but decided to remove it (0.04)
				3D Display or interactive panel (0.1)
				We would like to include 3D Display or interactive panel (0.5)
				We had 3D Display or interactive panel but decided to remove it (0.5)
				Interactive installation (0.1)
				We would like to include Interactive installation (0.5)

Appendix A continued

				We had Interactive installation but decided to remove it (0.5)
				Chatbot (0.2)
				We would like to Chatbot (0.1)
				We had Chatbot but decided to remove it (0.1)
				Videogames (0.1)
				We would like to include Videogames (0.5)
				We had Videogames but decided to remove it (0.5)
		Digitization of the collection (0.5)	2. Is there a digitalized version of the museums' artefacts?	Less than 25% (0.25)
				25%-50% (0.5)
				51%-75% (0.75)
				More than 75% (1)

Appendix A continued

				No (0)	
	Data Analytics (0.4)	Digital Archives (0.5)	3. To what extent is your collection catalogued?	Paper catalogue (0.25)	Technology not adopted (1)
					1%-25% (0.8)
					26%-50% (0.6)
					51%-75% (0.4)
					76%-99% (0.2)
					100% (0)
				Database catalogue (0.25)	Technology not adopted (0)
					1%-25% (0.2)
					26%-50% (0.4)
					51%-75% (0.6)

Appendix A continued

					76%-99% (0.8)
					100% (1)
				The cataloguing is handled through a proprietary software. (0.25)	Technology not adopted (0)
					1%-25% (0.2)
					26%-50% (0.4)
					51%-75% (0.6)
					76%-99% (0.8)
					100% (1)
				The cataloguing is handled through an ICDD or Region	Technology not adopted (0)

Appendix A continued

				proprietary Information system (0.25)		
					1%-25% (0.2)	
					26%-50% (0.4)	
					51%-75% (0.6)	
					76%-99% (0.8)	
					100% (1)	
		Data storage and gathering (0.25)	4.Do you gather data about visitors?	Yes, with paper (0.1)		
				Yes, in an excel file (0.5)		
				Yes, in an appropriate software (1)		
				No (0)		
		Data monitoring (0.25)	5. Do you monitor data about your social	Yes (1)		

Appendix A continued

			network channels? (0.5)	
				No (0)
			6. Do you monitor data of online reviews?(0.5)	Yes (1)
				No (0)
	Technological infrastructure (0.2)	Wi-Fi presence (1)	1. Does your institution have a wi-fi connection?	Yes (1)
				No (0)
Process (0.1)	Front-office (0.5)	Prerequisite	Does your institution have a ticketing service?	Yes > Include front-office
				No > exclude front-office
		e-Billing process (0.6)	1. Which kind of ticketing service is	paper bill and paper accounting (0)

Appendix A continued

			present in your institution? (more than one answer is possible)	
				paper bill and digitalized invoice (0.2)
				e-ticket printable at home (0.3)
				e-ticket not printable (you can see from phone) (0.5)
		Access control (0.4)	2. How do you control visitors' access? (more than one answer possible)	We do not check visitors' access (0)
				Paper ticket control at the entrance (0)
				Bar code pistol reading paper (0.19)
				Bar code pistol reading screen (0.19)
				QR code reader (0.19)
				Gates or automatic people counter (0.19)
				Paper file (0)

Appendix A continued

				Excel file (0.14)	
				others... (0.05)	
	Back-office (0.5)	ERP Presence (1)	3. Do you have an informatic system that support these activities?	Accounting (0.1)	yes, dedicated or yes, shared with other institutions(1)
					No, not available or we do not manage this activity
				Supplier management (0.1)	yes, dedicated or yes, shared with other institutions (1)
					No, not available or we do not manage this activity

Appendix A continued

				Human Resources (0.1)	yes, dedicated or yes, shared with other institutions (1)
					No, not available or we do not manage this activity
				Customer Information Management (CRM) (0.1)	yes, dedicated or yes, shared with other institutions (1)
					No, not available or we do not manage this activity
				Cataloguing, conservation and ordinary	yes, dedicated or yes, shared with other institutions(1)

Appendix A continued

				maintenance of collections (0.1)	
					No, not available or we do not manage this activity
				Lending and moving of artworks (0.1)	yes, dedicated or yes, shared with other institutions(1)
					No, not available or we do not manage this activity
				Space Management (0.1)	yes, dedicated or yes, shared with other institutions (1)
					No, not available or we do not manage this activity

Appendix A continued

				Public services (bookshop,restaurant) (0.1)	yes, dedicated or yes, shared with other institutions (1)
					No, not available or we do not manage this activity
				Teaching activities (0.1)	yes, dedicated or yes, shared with other institutions (1)
					No, not available or we do not manage this activity
				Ticketing (0.1)	yes, dedicated or yes, shared with other institutions (1)

Appendix A continued

					No, not available or we do not manage this activity
Customer (0.2)	Customer Awareness (1)	Digital Marketing Activity (0.33)	1.Which one of these marketing activities do you perform (internally or externally)? (More than one answer is possible)	Newsletter (0.2)	
				online/social network advertising (0.25)	
				Search Engine Optimization (0.3)	
				Use of social media to convey internet traffic towards the website or other marketing practices (0.25)	
				None (0)	
		Social Media presence (0.33)	2. Which social accounts do you have? (More than one answer is possible)	Facebook (0.15)	

Appendix A continued

				Twitter (0.15)
				Instagram (0.15)
				YouTube (0.15)
				Pinterest (0.15)
				TikTok (0.25)
				None (0)
		Presence in reputation website (0.33)	3.On which of these review websites are you subscribed? (More than one answer is possible)	TripAdvisor (0.25)
				Google Maps (0.25)
				Facebook Place (0.25)
				Foursquare (0.25)
				None (0)

Appendix A continued

Strategy and investment (0.3)	Strategy (0.5)	Strategy (1)	1. Is there a strategic plan for digital innovation?	Yes, in a dedicated document (1)
				Yes, in another document (0.8)
				No (0)
	Investment (0.5)	Digital investment (0.5)	1. In which digital activities did you invest in the last 2 years? (More than one answer can be selected)	Cataloguing and digitization of collection (1)
				Conservation of collection (1)
				Services of visit support (1)
				Communication and customer care (1)
				Ticket, booking and access control (1)
				Security and surveillance (1)
				Education activities (1)
				None (0)

Appendix A continued

		Digital investment penetration	2. Which is the percentage of investment you committed to digital innovation?	1–5% (0)
				6–10% (0.2)
				11–25% (0.4)
				26–50% (0.6)
				51–75% (0.8)
				more than 75% (1)

Appendix B: The adapted Digital Readiness Questionnaire.

Dimension (w_i)	Sub-dimension (w_j)	Metric (w_k)	Question (Q_k)*	
People (0.2)	Digital skills (1)	Specialised personnel (0.6)	1. Does your institution have employees who	No (0)
				Yes, some people are in charge of managing digital activities, even if there is not a specialised team (0.5)

			specialise in information technology (IT)?	Yes, external consultants (0.5)
				Yes, we rely on a specialised team of X people (1)
		Access to Digital Skills (0.4)	2. Do any of these positions are present at your institution?	Digital Responsible (1)
				Social Media Manager (1)
				Digital Curator (1)
				Digital User Experience developer (1)
				Data Protection Officer (1)
				Others (1)
				(*List the roles in charge with work responsibilities similar to those above.)
				Does not present any of the listed position (0)
Technology (0.2)	Technology adoption (0.4)	Technology presence (1)	3. Which of these technologies are present in your	Audioguide (0.02)
				We would like to include audioguide (0.01)
				We had audioguide but decided to remove it (0.01)

			museum? (More than one answer is possible)	Augmented Reality (0.2)
				We would like to include Augmented Reality (0.1)
				We had Augmented Reality but decided to remove it (0.1)
				Virtual Reality (0.2)
				We would like to include Virtual Reality (0.1)
				We had Virtual Reality but decided to remove it (0.1)
				QR Code (0.08)
				We would like to include QR Code (0.04)
				We had QR Code but decided to remove it (0.04)
				3D Display or interactive panel (0.1)
				We would like to include 3D Display or interactive panel (0.05)

				We had 3D Display or interactive panel but decided to remove it (0.05)
				Interactive installation (0.1)
				We would like to include Interactive installation (0.05)
				We had Interactive installation but decided to remove it (0.05)
				Chatbot (0.2)
				We would like to Chatbot (0.1)
				We had Chatbot but decided to remove it (0.1)
				Gamification Stations (0.1)
				We would like to include Gamification Stations (0.05)
				We had Gamification Stations but decided to remove it (0.05)

				None of the listed above (0)	
	Data Analytics (0.4)	Digital Archives (0.5)	4. To what extent is your collection catalogued?	Paper catalogue (0.33)	Technology not adopted (1)
					1%-25% (0.8)
					26%-50% (0.6)
					51%-75% (0.4)
					76%-99% (0.2)
					100% (0)
				Database catalogue (0.33)	Technology not adopted (0)
					1%-25% (0.2)
					26%-50% (0.4)
					51%-75% (0.6)
					76%-99% (0.8)
					100% (1)
					Technology not adopted (0)
					1%-25% (0.2)

				The cataloguing is handled through other software (0.33) (Q5. list out the software your museum use for cataloguing)	26%-50% (0.4)
					51%-75% (0.6)
					76%-99% (0.8)
					100% (1)
		Data storage and gathering (0.25)	6. Do you gather data about visitors?	Yes, with paper (0.1)	
				Yes, in an excel file (0.5)	
				Yes, in an appropriate software (1)	
				No (0)	
		Data monitoring (0.25)	7. Do you monitor data about your social	Yes (1)	
				No (0)	

			network channels? (0.5)	
			8. Do you monitor data of online reviews? (0.5)	Yes (1)
				No (0)
			9. Does your institution have a Wi-Fi connection?	Yes (1)
				No (0)
Process (0.1)	Technological infrastructure (0.2)	Wi-Fi presence (1)		Yes (1)
				No (0)
		Prerequisite	10. Is there a ticketing service at your institution?	Yes > Include front-office
				No > exclude front-office
			11. What kind of ticketing service does your institution	paper bill and paper accounting (0)
				paper bill and digitalised invoice (0.2)
				e-ticket printable at home (0.3)

			provide? (More than one answer is possible)	e-ticket not printable (you can see from phone) (0.5)	
		Access control (0.4)	12. How do you control visitors' access? (More than one answer possible)	We do not check visitors' access (0)	
				Paper ticket control at the entrance (0)	
				Bar code pistol reading paper (0.19)	
				Bar code pistol reading screen (0.19)	
				QR code reader (0.19)	
				Gates or automatic people counter (0.19)	
				Paper file (0)	
				Excel file (0.14)	
				others... (0.05)	
	Back-office (0.5)	ERP Presence (1)	13. Do you have an informatic system that support these activities?	Accounting (0.1)	yes, dedicated or yes, shared with other institutions (1)
					No, not available or we do not

					manage this activity
				Supplier management (0.1)	yes, dedicated or yes, shared with other institutions (1)
					No, not available or we do not manage this activity
				Human Resources (0.1)	yes, dedicated or yes, shared with other institutions (1)
					No, not available or we do not manage this activity
				Customer Information Management (CRM) (0.1)	yes, dedicated or yes, shared with other institutions(1)
					No, not available or we do not manage this activity

				Cataloguing, conservation and ordinary maintenance of collections (0.1)	yes, dedicated or yes, shared with other institutions(1)
					No, not available or we do not manage this activity
				Lending and moving of artworks (0.1)	yes, dedicated or yes, shared with other institutions(1)
					No, not available or we do not manage this activity
				Space Management (0.1)	yes, dedicated or yes, shared with other institutions(1)
					No, not available or we do not manage this activity
					yes, dedicated or yes, shared with other institutions (1)

				Public services (bookshop, restaurant) (0.1)	No, not available or we do not manage this activity
				Teaching activities (0.1)	yes, dedicated or yes, shared with other institutions (1)
					No, not available or we do not manage this activity
				Ticketing (0.1)	yes, dedicated or yes, shared with other institutions (1)
					No, not available or we do not manage this activity
Customer (0.2)	Customer Awareness (1)	Digital Marketing Activity (0.33)	14. Which one of these marketing activities do	Newsletter (0.2)	
				online/social network advertising (0.25)	

			you perform (internally or externally)? (More than one answer is possible)	Website (0.3)
				Use of Social Media to convey internet traffic towards the website or other marketing practices (0.25)
				None (0)
		Social Media presence (0.33)	15. Which social media platforms did your museum use? (More than one answer is possible)	Facebook (0.15)
				Twitter (0.15)
				Instagram (0.15)
				YouTube (0.15)
				Pinterest (0.15)
				TikTok (0.25)
				None (0)
		Presence in reputation website (0.33)	16. Is your museum listed on any of these	TripAdvisor (0.25)
				Google Maps (0.25)
				Facebook Place (0.25)

			review websites? (More than one answer is possible)	Foursquare (0.25) None (0)
Strategy and Investment (0.3)	Strategy (0.5)	Strategy(1)	17. Are there any ideas or efforts in your museum to adapt to digital transformation?	Yes, in a dedicated document (1)
				Yes, in another document (0.8)
				No (0)
	Investment (0.5)	Digital investment (0.5)	18. In which digital activities did your museum invest in the last 2 years? (More than one answer can be selected)	Cataloguing and digitisation of collection (1/7)
				Conservation of collection (1/7)
				Services of visit support (1/7)
				Communication and customer care (1/7)
				Ticket, booking and access control (1/7)
				Security and surveillance (1/7)
				Education activities (1/7)
				None (0)

		Digital investment Penetration (0.5)	19. What is the estimated percentage of your museum's investment in digital innovation?	1–5% (0)
				6–10% (0.2)
				11–25% (0.4)
				26–50% (0.6)
				51–75% (0.8)
				more than 75% (1)

Appendix C: The Content Validation

Dimension: People				
Sub-Dimension: Digital skills				
Definition: Digital skills identify the way digital capabilities are managed internally and the existence of digital roles, whose competences depend on the sector of interest.				
Questions	Relevance			
In your institution, are there employees specialized in digital transformation?	1	2	3	4
In your institution, is it present any of these positions?	1	2	3	4
Dimension: Technology				
Sub-Dimension: Technology adoption				
Definition: Technology adoption refers to the acquisition of a certain technology within the Organization.				
Questions	Relevance			
Which one of these technologies is present in your museum?	1	2	3	4
Is there a digitalized version of the museums' artefacts?	1	2	3	4
Sub-Dimension: Technology adoption				
Definition: Technology adoption refers to the acquisition of a certain technology within the Organization.				
Questions	Relevance			

Appendix C continued

Which one of these technologies is present in your museum?	1	2	3	4
Is there a digitalized version of the museums' artefacts?	1	2	3	4
Sub-Dimension: Data Analytics Definition: Data analytics considers the systematic usage of online data to support decision-making processes				
Questions	Relevance			
To what extent is your collection catalogued?	1	2	3	4
Do you gather data about visitors?	1	2	3	4
Do you monitor data about your social network channels?	1	2	3	4
Do you monitor data of online reviews?	1	2	3	4
Sub-Dimension: Technological infrastructure Definition: Technological infrastructure is considered with reference to the presence of a Wi-Fi connection.				
Questions	Relevance			
Does your institution have a wi-fi connection?	1	2	3	4
Dimension: Process				
Sub-Dimension: Front-office Definition: Front office refers to the interaction with customers, with particular reference to the presence of an e-billing process				

Appendix C continued

Questions	Relevance			
Does your institution have a ticketing service?	1	2	3	4
Which kind of ticketing service is present in your institution?	1	2	3	4
How do you control visitors' access?	1	2	3	4
Sub-Dimension: Back-office Definition: The sub-dimension back office considers the extent to which internal processes are digitalized.				
Questions	Relevance			
Do you have an informatic system that supports these activities?	1	2	3	4
Dimension: Customer				
Sub-Dimension: Customer Awareness Definition: Customer awareness refers to the presence and usage of social media channels and localisation websites such as Google Maps and TripAdvisor				
Questions	Relevance			
Which one of these marketing activities do you perform (internally or externally)?	1	2	3	4
Which social accounts do you have?	1	2	3	4
On which of these review websites are you subscribed?	1	2	3	4
Dimension: Strategy and Investment				

Appendix C continued

Sub-Dimension: Digital Strategy Definition: Digital strategy measures the existence of a strategy and its integration with an organization's overall strategy.				
Questions	Relevance			
Is there a strategic plan for digital innovation?	1	2	3	4
Sub-Dimension: Investment Definition: The sub-dimension of Investment refers to the investment committed by the firm to digital technologies				
In which digital activities did you invest in the last 2 years?	1	2	3	4
Which is the percentage of investment you committed to digital innovation?	1	2	3	4

Appendix D: Online Survey

Questions in the online survey

The online survey consists of 3 sections, where

1. The first section is the consent form for museum managers to agree to participate in my research.
2. The second section consists of 6 questions related to demographic information of museum managers.
3. The third section consists of 19 questions that are related to the digital readiness of Malaysian museums.

Section 1

Consent Form

I am Sabine Chung Sze Yee (21020574) from Faculty of Cognitive Science and Human Development, currently studying master's degree in Cognitive Science.
The topic of my research study is "Digital Readiness for Museums in Malaysia.". This questionnaire is used for the purpose of collecting data and information to understand the digital transformation readiness of museums in Malaysia.
Participants are required to complete the questionnaires. All the feedback will be treated as private and confidential. Furthermore, you are required to fill out the consent form below. Your cooperation and time consuming are highly appreciated.

Thank you.

1

By clicking the box below, prove that you have agree to be a participant of this research. *

☐ I agree to take part in this research.

Section 2: Demographic Information

2

Name *

Enter your answer

3

Gender *

☐ Male

☐ Female

4

Occupation *

Enter your answer

5

Please provide the name of the museum where you are currently employed. *

Enter your answer

6

How long have you worked in the museum? *

- ☐ 1-2 years
- ☐ 3-4 years
- ☐ 5-6years
- ☐ 7-8 years
- ☐ more than 8 years

7

What is the annual average number of visitors visiting your institution? *

Enter your answer

Section 3: The Digital Readiness of Malaysian Museums Questions

8

Does your institution have employees who specialize in information technology (IT)? *

- ☐ No
- ☐ Yes, some people are in charge of managing digital activities, even if there is not a specialized team
- ☐ Yes, external consultants
- ☐ Yes, we rely on a specialized team of X people

9

Do any of these positions are present at your institution? *

(*List the roles in charge with work responsibilities similar to those listed positions if you select "Other")

- ☐ Digital Responsible
- ☐ Social Media Manager
- ☐ Digital Curator
- ☐ Digital User Experience developer
- ☐ Data Protection Officer
- ☐ Does not present any of the listed position
- ☐ Other

10

Which of these technologies are present in your museum? *

(More than one answer is possible) *

- ☐ Audioguide
- ☐ We would like to include audioguide
- ☐ We had audioguide but decided to remove it
- ☐ Augmented Reality
- ☐ We would like to include Augmented Reality
- ☐ We had Augmented Reality but decided to remove it
- ☐ Virtual Reality
- ☐ We would like to include Virtual Reality
- ☐ We had Virtual Reality but decided to remove it
- ☐ QR Code
- ☐ We would like to include QR Code

-
- ☐ We had QR Code but decided to remove it
 - ☐ 3D Display or interactive panel
 - ☐ We would like to include 3D Display or interactive panel
 - ☐ We had 3D Display or interactive panel but decided to remove it
 - ☐ Interactive installation
 - ☐ We would like to include Interactive installation
 - ☐ We had Interactive installation but decided to remove it
 - ☐ Chatbot
 - ☐ We would like to Chatbot
 - ☐ We had Chatbot but decided to remove it
 - ☐ Gamification Stations
 - ☐ We would like to include Gamification Stations
 - ☐ We had Gamification Stations but decided to remove it
 - ☐ None Listed Above

11

To what extent is your collection catalogued? *

(*Only answer No.11 if your museum has adopted **Other Software** to handle the catalogue)

	Technology not adopted	1%-25%	26%-50%	51%-75%	76%-99%	100%
Paper catalogue	☐	☐	☐	☐	☐	☐
Database catalogue	☐	☐	☐	☐	☐	☐
The cataloguing is handled through Other Software	☐	☐	☐	☐	☐	☐

12

List out the available software used by your museum if your museum handled the Cataloguing through other software.

(*Only answer if your museum has adopted Other Software to handle the museum collection catalogue.)

Enter your answer

13

Do you gather data about visitors? *

- ☐ Yes, with paper
- ☐ Yes, in an excel file
- ☐ Yes, in an appropriate software
- ☐ No

14

Do you monitor data about your museum's social network channels? *

- ☐ Yes
- ☐ No

15

Do you monitor data of online reviews? *

- ☐ Yes
- ☐ No

16

Does your institution have a Wi-Fi connection? *

- ☐ Yes
- ☐ No

17

Is there a ticketing service at your institution? *

(*Only answer No.17 and No.18 if you select "Yes" for this question)

- ☐ Yes
- ☐ No

18

What kind of ticketing service does your institution provide?

(More than one answer is possible)

***no need to answer if you have selected "no" for question 16**

- ☐ paper bill and paper accounting
- ☐ paper bill and digitalized invoice
- ☐ e-ticket printable at home
- ☐ e-ticket not printable (you can see from phone)

19

How do you control visitors' access?

(more than one answer possible)

***no need to answer if you have selected "no" for question 16**

- ☐ We do not check visitors' access
- ☐ Paper ticket control at the entrance
- ☐ Bar code pistol reading paper
- ☐ Bar code pistol reading screen
- ☐ QR code reader
- ☐ Gates or automatic people counter
- ☐ Paper file
- ☐ Excel file
- ☐ Other

Do you have an informatic system that support these activities? *

	yes, dedicated or yes, shared with other institutions	No, not available or we do not manage this activity
Accounting	☐	☐
Supplier management	☐	☐
Human Resources	☐	☐
Customer Information Management (CRM)	☐	☐
Cataloguing, conservation and ordinary maintenance of collections	☐	☐
Lending and moving of artworks	☐	☐
Space Management	☐	☐
Public services (eg. bookshop, restaurant)	☐	☐
Teaching activities	☐	☐
Ticketing	☐	☐

21

Which one of these marketing activities do you perform (internally or externally)?
(More than one answer is possible) *

- ☐ Newsletter
- ☐ Online/social network advertising
- ☐ Website
- ☐ Use of Social Media to convey internet traffic towards the website or other marketing practices
- ☐ None

22

Which social accounts does your museum have?
(More than one answer is possible) *

- ☐ Facebook
- ☐ Twitter
- ☐ Instagram
- ☐ YouTube
- ☐ Pinterest
- ☐ TikTok
- ☐ None

23

Is your museum listed on any of these review websites?
(More than one answer is possible) *

- ☐ TripAdvisor
- ☐ Google Maps
- ☐ Facebook Place
- ☐ Foursquare
- ☐ None

24

Are there any ideas or efforts in your museum to adapt to digital transformation? *

- ☐ Yes, in a dedicated document
- ☐ Yes, in another document
- ☐ No

25

In which digital activities did your museum invest in the last 2 years?
(More than one answer can be selected) *

- ☐ Cataloguing and digitization of collection
- ☐ Conservation of collection
- ☐ Services of visit support
- ☐ Communication and customer care
- ☐ Ticket, booking and access control
- ☐ Security and surveillance
- ☐ Education activities
- ☐ None

26

What is the estimated percentage of your museum's investment in digital innovation? *

- ☐ 1-5%
- ☐ 6-10%
- ☐ 11-25%
- ☐ 26-50%
- ☐ 51-75%
- ☐ more than 75%

Appendix E: The Dimension Score and the DRI of Malaysian Museums.

Name of Museums	People	Technology	process	customer	Strategy & Investment	DRI
Malacca Heritage Centre	0	0.3	0.2	0.182	0.722	0.333
STIDC Timber Museum	0.3	0.514	0	0.594	0.536	0.443
Tun Jugah Museum and Gallery	0.3	0.336	0.4	0.397	0.522	0.403
Muzium Perhutanan Negeri Kedah	0.4	0.096	0.3	0.182	0.5	0.315
Muzium Orang Asli Gombak	0.7	0.516	0	0.463	0.558	0.503
Sabah and Sarawak Judicial Museum	0.7	0.452	0.3	0.298	0.672	0.522
Muzium Warisan Lipis	0.7	0.454	0.318	0.611	0.622	0.572
Ho Yan Hor Museum	0.3	0.456	0.3	0.595	0.572	0.472
Muzium Petaling Jaya, Majlis Bandaraya Petaling Jaya	0.6	0.395	0.5	0.314	0.558	0.479
Lau King Howe Hospital Memorial Museum	0	0.198	0	0.463	0.036	0.144

Appendix E continued

Muzium Perhutanan Negeri Pulau Pinang	0.6	0.28	0.2	0.397	0.779	0.509
Galeri Tuanku Ja'afar	0.7	0.616	0.5	0.661	0.743	0.668
Han Chin Pet Soo	0.3	0.564	0.1	0.397	0.072	0.284
Johor Bahru Chinese Heritage Musuem	0.3	0.477	1	0.529	0.622	0.548
The Royal Press	0.7	0.468	0.7	0.347	0.586	0.549
Army Museum	0.4	0.568	0.6	0.562	0.658	0.563
Bentong Gallery	0.3	0.369	0.9	0.595	0.572	0.515
Royal Malaysia Police Museum	0	0.246	0	0.264	0	0.102
Muzium Negeri Sembilan	0.7	0.5	0.7	0.875	0.915	0.76
Muzium Rajo Istano Lamo Sari Mananti	0.7	0.5	0.7	0.875	0.915	0.76
Muzium Rembau	0.7	0.5	0.7	0.875	0.915	0.76

Appendix E continued

Teratak Zaaba	0.7	0.5	0.7	0.875	0.915	0.76
Muzium Negeri Kedah	0.7	0.482	0.4	0.413	0.672	0.561
Muzium Nelayan Tanjung Balau, Johor	0.7	0.672	0.31	0.578	0.793	0.659
Islamic Arts Museum Malaysia	0.3	0.518	0.5	0.727	0.915	0.634
Muzium Sultan Alam Shah	0.7	0.654	0.16	0.776	0.572	0.614
Muzium Gedung Raja Abdullah (Muzium Timah)	0.7	0.654	0.16	0.776	0.572	0.614
Muzium Insitu Jugra	0.7	0.654	0.16	0.776	0.572	0.614
Muzium Sabak Bernam	0.7	0.654	0.16	0.776	0.572	0.614
Muzium Sejarah Daerah Kuala Selangor	0.7	0.654	0.16	0.776	0.572	0.614
Galeri Arkeologi	0	0.25	0.4	0.528	0.708	0.408

Appendix E continued

Kompleks Muzium Diraja Sultan Haji Ahmad Shah, Kuantan	0.7	0.794	0.538	0.496	0.858	0.709
Museum of Asian Art	0.4	0.462	0	0.364	0.672	0.447
National Museum	0.3	0.794	0.488	0.694	0.708	0.619
Labuan Museum	0.7	0.356	0.6	0.463	0.436	0.495
Chimney Museum	0	0.126	0.4	0.298	0.536	0.286
Sungai Lembing Museum	1	0.389	0.1	0.397	0.472	0.509
Muzium Istana Kesultanan Melaka	0.3	0.404	0.59	0.809	0.793	0.6
Muzium Sejarah dan Ethnografi	0.3	0.404	0.59	0.809	0.793	0.6
Muzium Pendidikan	0.3	0.404	0.59	0.809	0.793	0.6
Muzium Sastera Melaka	0.3	0.404	0.59	0.809	0.793	0.6
Galeri Laksamana Cheng Ho	0.3	0.404	0.59	0.809	0.793	0.6

Appendix E continued

Galeri Demang Abdul Ghani	0.3	0.404	0.59	0.809	0.793	0.6
Galeri Golf	0.3	0.404	0.59	0.809	0.793	0.6
Galeri Seni Rakyat	0.3	0.404	0.59	0.809	0.793	0.6
Balai Seni Lukis Melaka	0.3	0.404	0.59	0.809	0.793	0.6
Muzium TYT Yang Di-Pertua Negeri Melaka	0.3	0.404	0.59	0.809	0.793	0.6
Muzium Pemerintahan Demokrasi	0.3	0.404	0.59	0.809	0.793	0.6
Muzium Islam Melaka	0.3	0.404	0.59	0.809	0.793	0.6
Muzium Rakyat	0.3	0.404	0.59	0.809	0.793	0.6
Muzium Layang-Layang	0.3	0.404	0.59	0.809	0.793	0.6
Muzium Kecantikan	0.3	0.404	0.59	0.809	0.793	0.6
Muzium Belia Malaysia	0.3	0.404	0.59	0.809	0.793	0.6

Appendix E continued

Muzium Samudera Fasa I	0.3	0.404	0.59	0.809	0.793	0.6
Muzium Samudera Fasa II	0.3	0.404	0.59	0.809	0.793	0.6
Muzium Setem Melaka	0.3	0.404	0.59	0.809	0.793	0.6
Muzium Dunia Melayu Dunia Islam	0.3	0.404	0.59	0.809	0.793	0.6
Muzium Chetti	0.3	0.404	0.59	0.809	0.793	0.6
Muzium Pulau Besar	0.3	0.404	0.59	0.809	0.793	0.6
Muzium Kapal Selam	0.3	0.404	0.59	0.809	0.793	0.6
Muzium Hang Tuah	0.3	0.404	0.59	0.809	0.793	0.6
Muzium Orang Asli	0.3	0.404	0.59	0.809	0.793	0.6
Muzium Adat Istiadat	0.3	0.404	0.59	0.809	0.793	0.6
Muzium Sejarah Dan Warisan Naning	0.3	0.404	0.59	0.809	0.793	0.6

Appendix E continued

Muzium Tentera Laut Diraja Malaysia (TLDM)	0.3	0.404	0.59	0.809	0.793	0.6
Malaysia Prison Museum	0.7	0.3	0.25	0.529	0.608	0.513
Muzium Adat/Custom Museum	0.7	0.253	0.2	0.562	0.4	0.443
Muzium Petroleum Miri	0	0.473	0.6	0.496	0.608	0.436
Muzium Arkeologi Niah	0	0.473	0.6	0.496	0.608	0.436
Muzium Wilayah Limbang	0	0.473	0.6	0.496	0.608	0.436
Muzium Wilayah Baram	0	0.473	0.6	0.496	0.608	0.436
Balai Seni Lukis Sabah	0.3	0.476	0.11	0.496	0.45	0.4
Muzium Geologi	0.7	0.366	0.3	0.083	0	0.26
Marine Museum Labuan	0.3	0.252	0	0.561	0.543	0.385
Muzium Seni Kraf Orang Asli	0.7	0.825	0.3	0.71	0.758	0.704

Appendix E continued

Muzium Etnologi Dunia Melayu	0.7	0.825	0.3	0.71	0.758	0.704
Muzium Tekstil Negara	0.7	0.825	0.3	0.71	0.758	0.704
Muzium DiRaja	0.7	0.825	0.3	0.71	0.758	0.704
Muzium Kota Kayangan	0.7	0.825	0.3	0.71	0.758	0.704
Muzium Arkeologi Lembah Bujang	0.7	0.825	0.3	0.71	0.758	0.704
Muzium Kota Kuala Kedah	0.7	0.825	0.3	0.71	0.758	0.704
Galeria Perdana	0.7	0.825	0.3	0.71	0.758	0.704
Muzium Perak	0.7	0.825	0.3	0.71	0.758	0.704
Muzium Matang	0.7	0.825	0.3	0.71	0.758	0.704
Muzium Automobil Nasional	0.7	0.825	0.3	0.71	0.758	0.704
Muzium Lukut	0.7	0.825	0.3	0.71	0.758	0.704

Appendix E continued

Muzium Seni Bina Malaysia	0.7	0.825	0.3	0.71	0.758	0.704
Muzium Kota Johor Lama	0.7	0.825	0.3	0.71	0.758	0.704
Fort Lily,Betong	0.7	0.618	0.56	0.611	1	0.742
Fort Emma, Kanowit	0.7	0.618	0.56	0.611	1	0.742
Fort Brooke, Julan	0.7	0.618	0.56	0.611	1	0.742
Muzium Budaya Borneo	0.3	0.617	0.298	0.611	0.729	0.554
Muzium Sarawak	0.3	0.617	0.298	0.611	0.729	0.554
Muzium Sejarah Cina	0.3	0.617	0.298	0.611	0.729	0.554
Muzium Warisan Islam	0.3	0.617	0.298	0.611	0.729	0.554
Muzium Semulajadi	0.3	0.617	0.298	0.611	0.729	0.554
Muzium Seni Sarawak	0.3	0.617	0.298	0.643	0.729	0.554

Appendix E continued

Muzium Tekstil Sarawak	0.3	0.617	0.298	0.611	0.729	0.554
Muzium Warisan Sri Aman, Kubu Alice	0.3	0.617	0.298	0.611	0.729	0.554
Rumah Sri Aman Galeri	0.3	0.617	0.298	0.611	0.729	0.554
Average Score	0.441	0.512	0.420	0.643	0.694	0.57