# Virtual Museums Technology: A Case Study in the UAE Museums

**تكنولوجيا المتاحف الافتراضية: دراسة حالة في دولة الإمارات العربية المتحدة**

**by**

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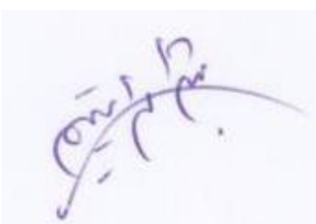

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## ABSTRACT

Along with the technological progressions, and the increase of mobile users, the need of keeping up with the times and developing a strong online presence is on the raise. Many institutions and organizations today strive to have that and many are working hard to create an online and mobile applications that will help cement their place with the <anytime, anywhere> today users.

Yet the situation of the museums around the world and especially here in the UAE is different, as current research about virtual museums in UAE shows that the museums are a bit lacking when it comes to the technology department, and although most UAE museums have undergone technological improvements, there is still a lack in applying virtual technologies or having a strong online presence that can serve the ever growing online crowds.

That's why this study has been conducted, its sole purpose is to review the museums history in general and the museums virtual history in specific. This study will also discuss the available virtual technologies that the museums can apply and test to improve their technological services to the public. However, no new technology comes without challenges, therefore several challenges that face the museums worldwide and precisely in the UAE when applying such technologies is highlighted as well.

The researcher has studied the situation of the UAE museums by examining four research questions about the use of virtual technology and how can it attract more museum goers. The methods used in the research were a conducted Case study of UAE museums and a questionnaire distributed among 186 members of the public.

The hypotheses was accepted and successful which resulted in proving the need of virtual technologies in UAE museums to increase the local insert in the country's museums.

## نبذة

تزامناً مع التقدم التكنولوجي ، وزيادة مستخدمي الهاتف المحمول ، فإن الحاجة إلى مواكبة العصر والتطور الالكتروني صار في ازدياد. تسعى العديد من المؤسسات والمنظمات اليوم إلى تحقيق ذلك ، ويعمل الكثيرون جاهدين لإنشاء تطبيقات على شبكةالإنترنت و الهاتف المحمول لتساعد على تعزيز مكانتهم مع المستخدين <أي وقت، أي زمان> .
ومع ذلك ، يوجد تباين في وضع المتاحف حول العالم ، خاصة في دولة الإمارات العربية المتحدة. حيث ان الأبحاث الحالية حول المتاحف الافتراضية في الإمارات تظهر أن المتاحف تفتقر إلى وجود مثل هذه التطبيقات و التكنولوجيا. على الرغم من أن معظم تكنولوجيا المتاحف في الإمارات قد خضعت التحسينات ، إلا أنه لا يزال هناك نقص في تطبيق التقنيات الافتراضية أو تواجد ملحوظ على شبكة الإنترنت الذي من الممكن أن يخدم الحشود المتزايدة على الإنترنت.
من هنا وجد السبب لإجراء هذه الدراسة ، والغرض الوحيد منها هو استعراض تاريخ المتاحف بشكل عام والتاريخ الافتراضي للمتاحف بشكل خاص. ستناقش هذه الدراسة أيضًا التقنيات الافتراضية المتاحة التي يمكن للمتاحف تطبيقها واختبارها لتحسين خدماتها التكنولوجية للجمهور. من جانب آخر ، لا توجد تكنولوجيا جديدة تأتي من دون تحديات ، وبالتالي هناك العديد من التحديات التي تواجه المتاحف في جميع أنحاء العالم وعلى وجه التحديد في دولة الإمارات العربية المتحدة عند تطبيق مثل هذه التقنيات و سيتم تسليط الضوء عليها كذلك.
قام الباحث بدراسة حالة المتاحف في الإمارات العربية المتحدة من خلال دراسة أربعة أسئلة بحثية حول استخدام التكنولوجيا الافتراضية وكيفية جذب المزيد من رواد المتاحف. الطريقة المستخدمة في البحث هي (دراسة حالة) تم إجراؤها لمتاحف دولة الإمارات العربية المتحدة واستبيان وزع على 186 عضوا من الجمهور.
تم قبول الفرضيات ونجاحها مما أدى إلى إثبات الحاجة إلى التقنيات الافتراضية في متاحف الإمارات العربية المتحدة لزيادة الإدراج المحلي في متاحف الدولة.



**Keywords:**

Virtual Museums, Technology, Local interest, online application

# Table of Content

# Chapter 1: Introduction

*In this chapter, a general overview is presented. The problem has been described. Study motivations are also defined. The aim and objectives of the research has been clearly specified. Furthermore, the research questions are described briefly. The used methodology is illustrated. The dissertation structure and chapters explanation are presented.*

## 1.1 Overview

The technological revolution had a significant impact on the development of services in all areas, as most organizations and institutions took the advantages of the opportunity to build a technological infrastructure to consolidate and update their services.

Museums were particular beneficiaries, as they seized the chance to be more than only places of historical interest or value, broadening their original purpose as historically themed tourist sites by extending their services to create an environment which is interactive with visitors via Internet.

Museums currently use social media and the World Wide Web to interact and attract visitors and audiences. They also work on developing and using the latest technologies to serve visitors, educational purposes, and researchers. Efforts have even been made by a number of international museums to have a technology which aims to attract more people and spread the museum name worldwide.

Virtual technology helps in such situations and allows innovators to develop online attractions, but also to promote the physical site. In essence, virtual museums inspire motivation for the tourist to visit the physical museum to discover more about the story of museum, the collections and the events revealed on the website itself.

Based on the vision of H.H. Sheikh Mohamed Bin Rashed AlMaktoum in order to provide the happiness to the customers by applying the technology and build smart infrastructure. UAE museums set their sights on applying H.H vision and worked hard to develop the infrastructure technology to provide high services and benefits to the visitors and audiences.

## 1.2 Research Problems

It is notable that UAE organizations are always looking for applications to better their services to serve consumers, in addition to continually upgrading the existing technology in all organizations to be a state of the art and up to date with the times, with museums being part of the ongoing development. Yet there has been minor delays.

Although museums have notably been developed and improved over a sustained period of time, there is evidence of restraint in adding some updated technologies to provide the user with the necessary tools to interact with the collections, and the museum's internal exhibitions. There is little doubt that upgrading the technology would assist in increasing customer interest in museums and their many culturally and historically significant artefacts.

We can also see that museums are still using traditional showcases to present the collections, while additionally there is no system to track the items location or the means to present them online. Moreover, there is a marked decrease in the number of visitors to some museums, suggesting that there is little or no interaction between visitors and the museum collections or events on a promotional level. Furthermore, it is notable that most museum visitors are non-local UAE residents or tourists, while the UAE locals have no to little interest in visiting the museums and their exhibits. Of course this brings us to the necessity of what could be done to increase the level of UAE locals coming to the many museums and exhibits around the country.

## 1.3 Motivation

In the literature, it has been observed that UAE museums compared with international museums are lacking in having documented researches and virtual museums/ events projects. By Working in the IT section of Sharjah Museums Authority I was inspired to develop the research for a new service that will take UAE museums in a new technological direction that will serve as an anchor to promote the museums as well as attract more visitors. The new research was for a virtual museums and exhibit technology that would have allowed people from all around the world to view our museums and have an idea about their content.

Noting a disparity, I was motivated to look more into virtual museums, and research the possibilities of applying such an advanced technology to our museums.

In addition, I have noticed from my communication with people while traveling that they are interested in our country's history and culture, people have the desire to know more about us.

However, distance becomes a major factor in tourist choice, and the inability to travel to our widespread exhibits ultimately prohibits the customer interest. So what's the next best thing when visitors can travel, virtual museums. Where visitors can attend and satisfy their curiosity about our history and culture, and additionally, market the UAE museums worldwide with an advanced technology systems.

## 1.4 Aim and Objectives

This research aims to present the benefits of virtual museums technology to museums around the UAE, and also to highlight some other related technologies that would improve museum services and outlook to customers; in addition to surveying visitors' perspectives and opinions about virtual museums.

Plus it will showcase the obvious challenges that faces the museum staff when planning to implement such technologies and services. Last the research will analyze the findings and propose possible solutions and recommendations for such obstacles.

With regarding to the objectives, as we all know, technology has become one of the leading lifestyle factors within our present society, both on a personal level, and professionally in our work. And certainly it contributes to our daily experiences in the private sector and the public domain.

Museum and heritage curators are also advocating for the use of technology in their line work, since technology allows them to bridge the gap presented by the traditional practices, allowing them to safeguard and preserve the value of their work and the objects of their collections.

That's why researchers are constantly developing new applications, standards and programs to reach the highest levels of technological development and to push beyond present boundaries that limits and controls the freedom of showcasing the museum collectibles and exhibitions. Keeping in mind the following priorities of differentiating between the several types of visitors that visits the museums, some go for research reasons, while others for education and the access to public information. Another priority is the documentation of all historical and heritage places and artifacts that is collected by museums around the UAE. Each piece and place should be accounted for and archived for future references and use.  More to say many technologies can be applied and/or improved to meet the museum's requirements and to attain the needed results and to satisfy the customer we well.

### 1.5 Research Question

As there is less interest from UAE natives in museum tourism in the UAE, the local government aims deploy more ways to attract museum goers, thus, it is necessary to focus on applying virtual museums/ exhibitions which are one way to attract the public and to be able to do that, the following questions must be answered:

- ***Is applying virtual technology in UAE museums will raise Local interest?***
- ***Is applying virtual technology in the UAE museums will be a challenge?***
- ***Is applying virtual technology in UAE museums will attract visitors from different Age groups?***
- ***Is applying virtual technology in UAE museums will raise Local interest based on Emirates?***

### 1.6 Methodology

The methodology used in this research is a mix of two methodologies together which are the **Qualitative approach** and the **Quantitative approach**. The qualitative approach used in the research are observation source, interviews and phone calls. On the other hand, the quantitative approach used was the questionnaire survey.

The first part of the research will be the qualitative method which includes a case study of the UAE Museums. The study is to review the museums history and the technologies used to present the collections and artifacts. Moreover, the study will observe the UAE museums status along with the technological techniques used to attract and serve visitors. Our scope is to collect data from different museums in the different Emirates in UAE to review and illustrate the existing situation of the museums especially the technologies used.

The second part of the research, a quantitative method is proposed which relies on the questionnaire survey proposed which will be distributed to the visitors and audiences from different Nationalities, ages and Emirates via social media.

In order to analyze and explain the dependents and independent variables used in the research, the following formula will be used:

$$\mathbf{Y= \beta\ 0+ \beta 1x1+ \beta 2x2+ \beta 3x3+ \beta 4x4}$$

The Y factor describes the dependent variables in the study paper which is how to increase the number of UAE museum visitors and raise the local interest. Our independent variables, which are on the right side of the formula, describe 1- **Nationality** 2- **Challenge** 3- **Age Groups 4- Emirates.** The Statistical Package for the Social Sciences (SPSS) software is used to analyze the questionnaire survey items. SPSS has a main strength in doing the research study such as analyzing the information and illustrating them into statistical numbers and diagrams which makes the analysis easier to present and to understand the results to prove the researched data efficiency. The findings will help us in providing a clear vision on the people perspectives about the museums in UAE and the technological services available.

## 1.7 Dissertation Structure

The structure of the dissertation is divided into five chapters, which are as follows:

**Chapter 1**: Introduces the overview of the study. In addition to the problem definition and the research questions which are clearly discussed. The chapter also highlights the aim and the objectives along with the motivation and the research methodology which are clearly described.

**Chapter 2**: Reviews the museums history and the evolution of the expansion of museums. It also discusses the definition of virtual museums and the special different techniques in virtual technology. Moreover, it explains the technological experiments that have been applied in some international museums.

**Chapter 3:** Illustrates the study methodology which has been used. It highlights the research questions that the study intended to examine in details. The chapter also presents where the data has been collected from and the methods being used. It includes a case study about the museums in the UAE and a survey that helps in answering and tying the research questions with the findings.

**Chapter 4:** Analyzes and discusses the findings of both the study and the survey. The chapter presents in details the status and the existing situation of the UAE museums and the technologies that are being used by them. The dependent and independent variables are presented and explained in details along with the research questions and the findings from both the case study and the survey.

**Chapter 5:** Discloses the conclusion of the research in addition to some recommendations that can be applied in the future for better research and work practices.

# Chapter 2: Literature Review

*Since 18th century, the museums vision of illustrating the artifacts and collections to the public has been changed. Starting from photo album, reaching to the addition of the virtual technologies to museums galleries and the publishing of the collections via the internet. The technology revolution provided a huge impact on most businesses as well as the educational institutes. Museums are considered as much as an educational organizations as they are a cultural associations in all societies. Many researches and projects been made to know the impact of virtual museums on visitors satisfactions and how can virtual museums affect the number of museums visitors. This study attempts to describe the development of museums and to detail the use of virtual technology and applying its different aspects for general use. In addition, the paper describes some virtual techniques that can be used by museums to allow the visitors to interact with the collection and to raise the visitors' attendance. Some projects and experiments made by some museums in Europe is present in order to describe the success of the investigation. Finally, the researcher conclusions will be presented.*

## 2.1 Introduction

The word or the concept of Museums have always given the people the assumption and the image of a heritage building that houses historical collections and artifacts. Many people believe that museums are just a place to store old objects. All the while, the museums have permanently provided both the people with both cultural and educational knowledge about their history and culture.

Ten years ago, the definition of the virtual museums was not understandable or acceptable enough to both the public and the museums' professionals. Because the technology was not yet advanced to reflect what the museums wanted to show case, and for the fear that the public people will not accept the concept of the virtual museums. Moreover, the museums professionals thought that the virtual museums might affect the museum's operation and its visitors' number. In addition, there was a confusion whether it would be possible for the virtual museum to get the proper attention that the physical museums acquired in their own right.

Below the researcher will also examine the benefits of virtual museums, showcasing some museums events and exhibits and satisfaction of those visitors who were attracted to the actual museums after viewing exhibits/events virtually. Furthermore, the importance of the museums own history and the efforts that were put in by the museums' professionals to improve the services and facilities to the public will be discussed. What's more, the researcher will highlight the available virtual technology and techniques in addition to reviewing some experiments of museums from around the world who tired and successfully hosted some virtual galleries to the public.

In this chapter, we will review the museums own histories, plus the status of the museums and the technologies used by them to serve the public. Additionally, the definition of both museums and virtual museums will be explained, plus there will be an illustration displaying the differences between the both of them.

Then the chapter will advance to discuss the following: section 2 will present the challenges faced by museums' professionals in presenting the artifacts and improving their services. Section 3 will present the different types of mobile and virtual technologies showcasing different projects in different fields. Section 4 will demonstrate some projects done by museums in order to get the visitors feedback on the virtual technology and virtual events done in the museums, the last chapter will clarify the challenges of applying virtual museums technology in modern day museums.

## 2.2 Background

### 2.2.1 Museums

The word Museum is derived from the Greek word "*mouseion*" which means the place where Muses Dwell, the goddesses of art and science. The Muses were the sister goddesses who were responsible for entrancing and inspiring literature, science and art. They were long thought of as the source of inspiration and guidance for the musicians, historians, poets, dancers and others who are interested in the arts throughout history (Latham & Simmons, 2014). According to The World Museums Community (ICOM), the definition of museums explained as follows, "the museum is 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." Moreover, Johnson's point of view is that the museums are a great mechanism of preserving, interpreting, researching and illustrating heritage (ICOM, 2007)

When museums were first built, the museums' curators started to present their own collections as valuable exhibits; (a treasure and legacy from the past), which were only viewed by the visitors who were interested in academics and educating themselves about the showcased pieces and artifacts. Therefore, we can conclude that since the start, the museums were educational institute first and for most. More to say that preserving the traditional form of the museum, for example if it was an old significant building with a location filled with history will surely increase the value of the museum as well. Additional reasons for visiting museums were human curiosity to know more about the past and to broaden the knowledge of history and the valuable objects displayed (Duncan & Wallach, 1980).

Today, the image of the museums has changed. It is no longer attached to a significant historical building with the traditional architectural engravings we all attribute to museums: anywhere can be a museum, as you can find museums in houses, farms, castles or shopping malls and parks (Hooper-Greenhill, 1992).

In the 19$^{th}$ century, museums became open to the public for exhibits and study purposes rather than the private exhibit institute from the past, where only a selection of the society who had access to them. That period was known as "The Museum Age." According to J.V. Maranto, museums were always run and worked as they operate today. Furthermore, modern museums became the centers of Institution and Research (Maranto, 2015).

In the past there have always been a confusion when it came to categorizing and classifying museums. The studies have found that the museum can be rank based on the number of collections, type of collections and the number of visitors (Ginsburgh & Mairesse, 1997) . According to a later study conducted by Ginsburch and Mairesse, museums have been classified into five categories which are: History & Archeology, Science, Technology, ethnography and Art which includes religious art museums and decorative art museums. Any other types will come under mixed museum category (Ginsburgh & Mairesse, 1997).

On the other hand, there is a new category of museums that has been created by ICOM, which are the Historical Houses Museums. This type of category of museums has a special importance. Since the aspect of this museum is to present the history of the building, furnishing and owners' private/public collections (Pinna, 2001). The power of these types of museums lies in putting the visitors into a direct contact with the history that is difficult to change or modify. Mainly because these building are fossilized which keeps the meaning of the history and its significance intact, suspended in time, and that can take the visitors back in time through history. (Pinna, 2001)

Conversely, curators should also pay attention to the documentation and the archiving of the classified categories of museums along their collections for safe keeping based on each piece/artifact period and type.

### 2.2.2 Virtual Museums

In the 18th century, artists and museums' curators thought that real collections or art is the only one that is available and showcased within the museums walls, while any other work outside this space wasn't considered as art or a valuble artifact. Moreover, the museum can display only around 30% of the collections and objects at a time in one of its exhibitions. Here where virtual exhibition or virtual museum play an important role in displaying and illustrating more of the collections and artifacts at a time (Cameron & Mengler, 2009).

The idea of a virtual museum or digital museum started in the 19th century. The limitation of technology and digital methods was a barrier in front of the curators to innovate and spread their museum's collections worldwide (Marstine & Giebelhausen, 2008). Giebelhausen and Michaela discussed that virtual museums could be any type of media that is use to develop and innovate the display of museum's objects and collections. This media can be any system of hand-held information devices, kiosks, exhibition supports, art installations and archiving systems which use to re-organize working practices, and also to record and track the number of visitors. Moreover, the media can be involved in the museum to translate the older & traditional practices and demonstrations into digital forms (Marstine & Giebelhausen, 2008).

The first idea of a virtual museum was in 1947, when André Malraux wrote the book “Musée Imaginaire.” The book presented the artwork and paintings to the public, in a first time setting outside the walls of a traditional museum. The book was distributed in different places and translated into different languages, which made the art outside the walls of a museum more reachable and relatable. (Huhtamo, 2010).

According to Huhtamo, The main challenge faced by museums’ curator is presenting the collections and attracting audiences. The internet technology has created the opportunity to enhance and improve museums’ services. Since the early days of this new techno-age, different ways of communication were being used, such as emails, newsgroups and the World Wide Web (www). Having an electronic network allows and helps the organizations in having faster communication between curators and their customers. Along with these efforts, “The Museum inside the Telephone Network” was one of the most influencing exhibitions organized by the Japanese Telecom NNT in 1991. Home users were allowed to access the exhibition using telephones and faxes since the internet wasn’t available in Japan those days. Four years later, another exhibition was held in 1995 titled “The Museum Inside the Network.” In this project, the museum re-displayed the 1991 collection again, however this time it was done by using the internet (Huhtamo, 2010).

Furthermore, many reports and experiments have been conducted to understand the interest of the museums’ visitors. These reports showed that there was a lack in attracting visitors when the visitor cannot understand the meaning of the objects displayed. As well as, when the visitors had no opportunity to interact with the artifact up close, which caused an issue with the decline of the number of visitors to the museums (Schweibenz, 1998).

Moreover, with the technological advancements, many educational institutions took the opportunity of the internet to create an online educational components with links that refrenced museums’ collections. The online exhibitions can rang from images, videos, objects and other materials which cannot be present and/or examined properly in details in the physical exhibition.

With having online exhibitions, museums can also target different audiences from different age categories that spread into a wide geographical expanse (Fabunmi, et al., 2009)

More to say with regards to the advocates and one of the successful virtual museums projects, the Museums with No frontiers, which is a program that involves the public and private partners from all over the world and helping those with showcasing images of their collection virtually. The MWNF has an experience of more than 20 years in reviewing history and historical artifact and participating in different projects in the field. Their work is split between MWNF virtual museums and MWNF Galleries & Exhibitions (Schubert, n.d.).

In 2007, a new section of the largest Virtual Museum in the world has been created. "Discover Islamic Art" is one of the projects that MWNF initiated to combine different museums from Europe and the Mediterranean. 18 museums have participated in this project to illustrate around 1500 works of Islamic art and architecture all in one database. The works presented started in the Umayyad period until the beginning of the Ottoman Empire from different countries like Portugal, Jordan, Egypt, Italy, Tunisia, Morocco, Turkey, Spain, Palestine, Syria and Algeria (Schubert, 2016).

Overall, the idea of converting any museum to a virtual one in point of view of the researcher is one of the greatest ideas that can be applied in order to expand the presentation of the valuable museum collections and artifacts. Moreover, Museums with No Frontiers did a good job by establishing a free of charge website to illustrate any museum virtually, however, it still needs more efforts and work to improve and develop the collection displayed, since for now, you can only display images taken by museum's curator and not the artifact itself in 3D or 4D imagery. The website only present some pictures of the collections available in the participants' museums, whereas, the technology have advanced and developed beyond just displaying images, and there are many new ways to display the collections such as by video or multimedia software.

## 2.3 Virtual Museums Challenges

### 2.3.1 Museums visitors

Attracting people to visit museums is one of the most important challenges that face the museums' professionals according to Burton and Scott. Different researches were made about the subject of attracting museums visitors and it has been found that the museums from around the world are face the same challenge. A study have been conducted in countries like Germany, Denmark, Italy and Australia has found out that the decreasing number of museums visitors had a particular relation to the explosion of the internet (Burton & Scott, 2003).

Visitors' age group also played a factor in the challenges that face the museums when applying virtual museums technology. Since building an application that would user friendly, and understandable by all age groups is challenge, and the museums need to consider the different age groups and visitors categories when constructing such technologies, for each age group category will have different requirements and needs when viewing different objects and artefacts that were digitalized and virtualized for the use of the virtual museums applications (Urban, 2007).

### 2.3.2 Technology Impact

Some researchers believe that technology have made a major impact on the museums and their visitors requirements. As mentioned by Burton and Scott, that some researchers like Maggi and Anderson found that the visitors demanded having more interaction with the museum's collections and objects. Moreover, the internet and advancement in technology led to people who spend more time at home which consequently resulted in people who demand getting more information about museums and their collections online, rather than having to go physically and view those collections in real life. (Burton & Scott, 2003).

Digitalizing the cultural and heritage objects is another challenge for museums. To achieve this goal, different applications, software and hardware are required. For example, server storage is needed to store the 2D and 3D data and databases are needed to save the record of all digitalized objects. Moreover, the limitation in network bandwidth dose present an additional challenge when uploading/downloading the digital information (Tonta, 2008).

## 2.4 Virtual and Mobile Technologies

According to the study carried out by Trang, Yu and Liou on the use of virtualization technologies and their application on mobile phones and tablets. They found that people find it easy to use and move while using mobile phones and tablets they use their portable devices more than they use their own personal computers. The study also worked on the use of some techniques that can be employed, such as RFID, Augmented Reality and Virtual Reality and the possibility of using these technologies in education. The researchers in this study have agreed that the mobile and tablet applications are more useful, simple to install and it's easy to be connected at any time anywhere while using them, in addition they always tend to have a very user friendly interface (Tarng , et al., 2013)

### 2.4.1 Virtual Technology

#### *2.4.1.1 RFID Technique*

The RFID is one of the techniques that is used in virtual technology. RFID is considered as one of the simplest virtual technologies and the cheapest as well. When the researchers were working on developing a useful technology that achieves the required objectives with fewer investments, Bouchard, Gaboury Moutacili and Bouzouane used the RFID technology in their research for a project they called "SMART HOME." The system that the researchers created was about locating the objects and collections at homes and monitoring their movements. The system required no batteries and it relied on the aerial to provide the energy for it to operate plus it used the sound waves to help it in tracking the movements of the objects around the house (Bouchard, et al., 2014).

Another study by Joho, Plagemann, Burgard, listed the advantage and the disadvantages of the RFID technology. Starting with advantages, the RFID technology acts as a moving digitalizing archive system that replaces the outdated archiving system of having to collect all documents and objects in place and manually scanning each and every one of them. Secondly, this technology is known to be a safe and secure way to transfer the data accurately over short distances. On the other hand, the disadvantages of this technology is that the data can not be transfer over long distances, As the transmission over long distances is not stable and might get disconnected. Another disadvantage is that the system is not fully aware of the data that it records, considering that if an object was recorded and transmitted changed its location, the RFID system will take a new record of it as a new object disregarding that it already took the same record but in a different location. Which causes inaccurate and duplicated data entries (Joho, et al., 2009)

#### *2.4.1.2 Augmented Reality Technology*

Augmented Reality technology is another form of virtual technologies that is being studied by .Carmigniani, Furht, Anisetti, Ceravolo. Damiani and Ivkovic. The Augmented Reality is defined as “a real-time direct or indirect view of a real-world physical environment that has been enhanced / augmented by adding virtual computer-generated information to it.” (Carmigniani, et al., 2011). The AR is being used in different fields, like education, entertainment and health.

Those fields use the augmented reality mobile systems especially since it includes mobile phone applications. In addition, there are different AR interfaces that are being developed in order to create an interaction between the user and the tracked object (Reitmayr & Schmalstieg, 2003). There are four main ways of interaction in the augmented reality application which are: tangible AR interface, Collaborative AR interfaces, hybrid AR interfaces and the emerging multimodal interfaces which is the most recent and most developed application that used most by researchers (Kato, et al., 2000).

### 2.4.2 Mobile Technology

#### *2.4.2.1 Mobile Cloud Computing*

The cloud computing and mobile applications were the highest technology trends in recent years. Many mobile and smart devices applications use the cloud computing application to deliver enhanced services to the users (Liu , et al., 2013). Furthermore, the benefits of cloud computing in the mobile devices lies in enhancement of the competencies in three aspects which are: Storage, Networking and computation. The Mobile Cloud Computing helps in creating a virtual link between the data and mobiles via Internet. This is acheieved by creating a virtual environment between the data and the servers (Satyanarayanan, et al., 2009).

#### 2.4.2.2 Recommender Systems (RSs)

The Recommender Systems are basically an information filtering system that is used to predict the rating or preferences given by the end-user about any information item or social components which are not yet measured (Gavalas, et al., 2014). The recommender system generally focuses on specific media items like CDs or news, due to the graphical interface used by them. The main technique of recommender system is recommendating techniques as it is use to generate users' suggestions and recommendations then it works on customizing and filtering the results to deliver additional and new effective suggestions for any type of subject or item. In addition, this system have been used in different fildes like education, media, shopping and trousirm (Ricci, et al., 2011).

## 2.5 Museums' Technologies

"Talking museums" was one of the projects that developed and was managed by the High Technology District for Cultural Heritage management. The project idea was to use a novel services platform for the Cultural Heritage domain. The project depended on using the Internet of Things technology with the purpose of making the museums' objects able to "talk" during users' visit and able of automatically tell their story by using multimedia Services (Amato, et al., 2013). The main components used to accomplish the project were: Wireless Sensor Network, Gateway Server, Multimedia Content Server and Multimedia Guide Application. The project results showed that the method was successful and promising for further research and future implementation.

Pantile, Frasca, Mazzeo, Ventrella and Verreschi felt the need that the museums should use the recent technologies in their exhibitions. This was to enhance the visitors' attraction to the museums, and it gave the visitors the opportunity to interact with museum objects during their visits. ETT developed projects to prove the idea that using technologies will enhance the attraction of museum visitors. **Glass Beacon Museum** was one of those projects which used the augmented reality technology in attracting museum goers (Pantile, et al., 2016)

The researcher finds that all the above technologies are very useful and helpful if they were to be applied in UAE museums, since creating new virtual museums or applications by using such technologies will attract more people and visitors to the museums. Moreover, the experiments of using such technologies approved to be very successful when applied, since they have attracted the public from different visitors categories.

## 2.6 Conclusion

Museums were always considered as an educational institution as they provide a wealth of knowledge and history. The development and the improvement of museums during the past years and centuries gives the public the opportunity to discover more about history and heritage beyond the typical museums walls.

When the museums curators started to work in expanding the scope of the museums to reach to a wider span of the public, to give them a broader educational and cultural opportunities. The museums expansions took stages, it started with only pictures and photo of collections reaching today to virtual tours and galleries.

The technology revolution had a major effect in the museums history. This revolution gave the museums’ curators the opportunity to promote the museums via different more reachable mediums like internet and web pages. It became much easier for the public to get the information they need about any museum by just clicking on a link and they could reach any museum anywhere. Moreover, the mobile applications also gave the public and the audiences a chance to discover museums from different locations and places also from different countries. This kind of technology bridged the gap of distances and eased the communication between the people and the museums. In addition the technology increased the interaction between the visitors and the collections located in the museums.

Understanding the museums requirements along with the visitors’ requirements is the first step in examining the lack of visitors’ satisfaction during museum visits. Different tryouts and researches have been done by museums, students and researchers have proved that to improve museum services technology must be involved since online application, virtual galleries and events, reached to more audiences, and that’s a factor that every organization seeks to achieve, reaching and satisfying bigger numbers of the public by the services that they provide.

The literature review has covered the museum definition and history, virtual museum definition and history, then moving on to the mobile and virtual technologies available to use and apply. Later, the mobile technologies that can be applied and also used and improved to serve the public from different ages and education levels. The last part was about some technologies used in some museums and some projects that were conducted to test the benefits of some technology applications in museums. However, there was no literature that covered the UAE museums, and also there were no researches about the heritage museums and the historical houses in UAE. Although there are big numbers of historical building in each of the Emirates. So, the researcher proposed to study the UAE museums situation by visiting the different museums and by interviewing some staff members of those museums to know more about the collections available, the services provided and technology available in these museums.

# Chapter 3: Research Methodology

*This chapter illustrates the methodology used in the research to study and examine the status of UAE museums through its services, especially the technological services provided to visitors and to clarify and explain the efforts in order to attract more visitors. The chapter also highlights the research questions that this research proposed to examine. In addition, the study addressed the data which been collected from different places and people. The case study and questionnaire survey details been demonstrated.*

## 3.1 Research Methodology

The aim of the research is split into three, first is to examine the impact of virtual museums and online applications on the willingness of the public to visit the museums and the public satisfaction of the services provided by the management. Second, the research will survey the understanding of the Strengths and Weaknesses of the technological services provided by the museums the UAE. Thirdly, the researcher will inspect the lack UAE citizens' knowledge about UAE museums and decreasing the number of local interest.

Two methods been used to collect and test the required data, which are: Case study (qualitative method) and survey (quantitative method). The case study have been conducted about the UAE museums to test the hypothesis of the decreasing number of museum goers for the last three years and the lack of local interest. While the survey was distributed to the public to know their opinion about the museums in the UAE in general and technological services that they provide.

## 3.2 Research Questions

In order to investigate the hypothesis of the declining number of visitors to the UAE museums and the absence of the local interest despite the many events and exhibitions that been opened and arranged by the museums, the following research questions must to be observe.

**RQ1:** Is applying virtual technology in UAE museums will raise the Local interest?

**RQ2:** Is applying virtual technology in the UAE museums will be a challenge?

**RQ3:** Is applying virtual technology in UAE museums will attract visitors from different *Age groups*?

**RQ4**: Is applying virtual technology in UAE museums will raise interest based on *Emirates*?

## 3.3 Data Collection

The data is collected by two different techniques, the first technique was a conducted case study where the data and the information were collected by interviewing random employees in different museums around the UAE, via emails, phone calls or a face to face meeting. Moreover, the researcher have conducted a field research in some of these museums to collect the additional data and get a detailed information about the existing situation of current UAE museums operations and acquired technology. The second technique was a questionnaire survey that was distributed to the public via an online survey website and dispersed among different group of people in UAE and outside the UAE. The data been collected in the last quarter of 2016 up to the second quarter of 2017. The questionnaire was designed to collect further data such as personal information about the participants, and to gage the people interests in museums and their opinions about the technology used in those museums.

The responses that the researcher have gathered was to test and validate the relationship between the virtual technology and the increase of local interest to visit the UAE museums, which will ultimately increase the number of museum goers.

## 3.4 Case Study: UAE Museums

This case study covers in details the following about UAE museums: collection management, visitors' information and technologies available at UAE museums. The information has been collected from different museums in UAE in different Emirates. Some information was obtained by interviewing museums staff while the other half of the information about the different projects that the museums were running was obtained via email. Interviews questions are included in Appendix A.

The United Arab Emirates government has recognized the value and the importance of museums and worked to preserve the history and heritage of the area by developing and renovating the heritage buildings, historical houses and museums. Furthermore, new projects been placed to build new innovative museums which will contribute in education and raise the tourism in the country.

Each Emirate in the country has its own main museum that represents the United Arab Emirates culture, traditions and heritage. However, some Emirates have more museum than the others, such as the case in Dubai and Sharjah.

When it comes to the technological situation in those museums around the country, the researcher has observed the following, some museums do have a website that represents the information about the museum, alongside their vision & mission in addition to a section where they promote the upcoming exhibitions and museum events. Plus, most museums are using multimedia screens and videos in combination of the traditional showcasing of the objects and artifacts in the museum. Nevertheless, no additional mobile applications are available about museums or their collections that allows the visitors to interact with the objects and artifacts in a virtual reality manner. (AlMatroushi, 2016) (Zeyoudi, 2016).

The UAE has a huge number of historical and cultural buildings compared to the other countries in the Gulf area. This case study, focuses on the technologies used in the UAE museums and its impact on the number of visitors. In addition, the study highlights the impact of the lack of such technologies and the improvements that museum management will witness once they start to focus on applying them, and how those technologies can contribute in raising the number of visitors especially the locals.

Since 1969 the UAE government started establishing museums, Al Ain National Museum is known to be the oldest museum in UAE (Zaki, 2017). Today, Forty-three museums are available around the UAE from different categories like heritage, archaeological and educational. Additionally, the UAE government is working on constructing five new museums in different parts of the country. The new established museums aim to provide the highest museums' standards to the public and to conserve the museums' objects and collections using the newest most advanced technologies available.

With regards to museums' managements, the employees there also work on improving the technology used in the museums in order to enhance the appreciation of culture and give the visitors an opportunity of learning through the exhibitions, educational programs and public programs.

When it comes to challenges, different challenges stands in the way of the Museums Managements, when implementing or indtroducing new technologies for new or ongoing projects, especially when it's related to a historic building. According to AlQassimi, AlKhamees and Page, challenges are divided into internal and external challenges as explained below in table 1. Table 1 details the internal and external challenges of museums (AlQassimi, 2016), (AlKhamees, 2016), (Page, 2016):

| CHALLENGE | DESCRIPTION |
|---|---|
| **Internal Challenges** | |
| **Visitors Types** | Having different categories of museum's visitors is a challenge when it comes to meeting each and every of those category of visitors' requirements and needs when presenting the galleries, artifacts and exhibitions. The visitors' categories can be divided into students, researchers, tourists and the public. Each one of those categories has a different view and objectives about the aim of their visit to any museum. Also, the researcher have found that ages and education do play a role in here as well. Therefore, the ability to cater to each any every category does impose a challenge to museums everywhere (AlKhamees, 2016) (AlMatroushi, 2016). |
| **Exhibition and Educational Workshops** | When planning for an educational workshop and/or an exhibition the museum and the planner faces a huge challenge, since they are required to think of how they can attract different audiences from the different types of visitors' categories. The museum would like to attract different types of visitors and not only the ones who are interested in the field of whatever the museum is |

| | |
|---|---|
| | showcasing at time. Which leads to the draining of other resources such as money and human resources. For example, when acquiring an exhibition artifacts from other emirates or countries, the transportation and the insurance that the pieces will reach the distance unscathed proposes a challenge. Moreover, the same goes when presenting any workshop, the human resources will vary when presenting to adults/children or when presenting to disabled audiences (AlKhamees, 2016). |
| **Objects and Collections** | There is a lack of archaeologists and collections specialists personal in UAE museums. There is a great need for specialists who are experienced and trained in taking care of the collections and artifacts owned by those muesums. Moreover, presenting the objects themselves does propose a challenge by itself, since all objects and artifact showcase, must be showcased under ideal lighting and temperatures for example. Another challenge comes when the need to update the display arise, since the resources to handle the artifacts and exchange them are hard to come by, and this activity needs planning and preparation a head of time (Page, 2016). |
| **External Challenges** | |
| **Social** | The social challenges arise when people are not open to tell the stories about the heritage or the history of some locations and occasions. As some people feels and think that the retelling of stories of their ansestors lives is personal and should be kept a family secret. Additionally, the urban development plays a factor in the challenges presented to historical buildings, since erecting new buildings requires the demolishing of the historical houses/buildings. This type of demolishin causes the loss of history and the history of the families who owned the historical buildings and their ancestors who lived in them (AlQassimi, 2016). |
| **Political** | When talking about the political challenges, there are some sensitive political stories that can’t be published or presented. Also, researching or documenting some political stories and facts need approvals from management. Sharjah Museums Authority faced such a challenge while working on Sharjah Hisn |

| | |
|---|---|
| | project and collecting the needed information about the project as discribed by AlQassimi. (AlQassimi, 2016) |
| **Technological** | The technological challenges revolve in the rapid advancement and changes in technology itself. This requirs the need of being up-to-date with the technology services from around the world, starting from the infrastructure and reaching to the end user displays. Applying such technologies in museums requires money and acquiring new human resource who can apply those technologies as well as train the existing museum personal to keep up with changed in technology (AlQassimi, 2016) (Zeyoudi, 2016). |
| **Documentation/Research** | The challenge of historical documentation and research in the UAE museums lies in the absence of professional historians and researchers who document and search the history of the historical sites and the people who lived there. Although there are some organizations in the UAE that specializes in documenting and archiving historical documents, the historian researchers who work in those organizations, still face many difficulties in collecting the needed data (Page, 2016). |

**Table 1: Internal and External Challenges in museums**

All the museums in the UAE are working hard on building a strong technological infrastructure and providing high international IT standards. For example, Sharjah Museums Authority has been certified of ISO 20,000 which is a certification of IT service management (Information Technology Infrastructure library) (Zeyoudi, 2016) on the other hand, Ajman Museum has been Certified of ISO 9001:2008 (WAM, 2015). Museum IT departments around the UAE have worked hard alongside the strategic planning departments of all museums in the country to guarantee the presentation of the highest quality services to their visitors. Accordingly, different IT projects have been accomplished during the last ten years. The IT departments in most museums started building strong infrastructures to serve the customers' requirements along with the technological needs of the museums themselves. New networks have been installed in all UAE museums to allow the internal staff communication within their own museum as well as the external communication with other organizations.

More to say, the IT department efforts to advance the technology was not limited to the museums and its staff, it expanded to encompass the visitors as well. They started to work on providing additional services for the visitors such as adding some technologies that helped in growing and improving the museums services to the public. For instance, a website has been built to allow the visitors to get information about the museum and its news, events, educational programs and publications. According to Zeyoudi, Sharjah Museum Department keeps adding additional pages to their website to allow the visitors to search for the available collections in some of Sharjah's museums. Other technologies used in museums are collection management application named ADLIB. This application allows the staff to document object's details like the physical characteristics, its condition & conservation, inscription & making, acquisition and the location of the object (Zeyoudi, 2016), see pictures in appendix A. Furthermore, an audio guide is being used in some museums alongside interactive screens to present some historic documentations in some UAE museums or to display the information about the showcased collections. Additionally, TV screens are used to play videos and films about the history of the museums themselves or the history of the UAE (AlMatroushi, 2016), (Page, 2016).

In 2004, MWNF launched the Virtual Museum program, which allows different museums from around the world the use of a virtual environment to present their collections, archeological locations and put out exhibitions virtually to create relationships and share knowledge between theses participating museums. In 2012, Sharjah Museum of Islamic Civilization was chosen to be the first museum in UAE to display its objects on MWNF website. This specific museum was chosen to raise the awareness of the influence of the Islamic civilizations and its cultural identity among the Arab world and European continent. Moreover, this helped to create many new opportunities for cooperation between cultural heritage experts from different regions. Then, on 20 May 2015, Sharjah Museums Authority hosted the exclusive launch of "Sharing History" Project, in which Sharjah Museums Authority became a strategic partner with MWNF. This event/project was the only of its kind in the Arab world (AlKhamees, 2016)

Although there are different technologies used by the museums to showcase the collections, there is still lack of detailed information about each of those objects and collections. Most of the museums in the UAE still use the glass showcases to represent their collections. This technique allows the museum to present only 30% of the available collections as mentioned in the literature review above (Cameron & Mengler, 2009). Even if the staff are documenting the objects information in details in their own private applications, the museum goers can only browse simple basic information about the objects displayed in the museum or online like objects name, material and object number. These baisc information about the collections and artifacts might not be what the visitor or the online browser are looking for, since people would always like to know more about the pieces that they are looking at or browsing online (Page, 2016).

As observed by the researcher the only online technology used by most UAE museums is the website. The mobile application is not yet built or even designed by any museums' department in the country.

More to say, it can be noticed that the museums in the UAE still count the museums' visitors by those who are visiting the museum per the day. This number can depend on the occasions and activities that the museums offers on any given day. Sharjah Museums Authority can be presented as an example. The statistics of the number of museums' visitors between 2014 and 2015 showed that there was a decline in visitors in some museums. The percentage of decline varied between the museum's categories. Figure 3.1 shows the level of differences in number of visitors from 2014 and 2015 (Museums, 2016).

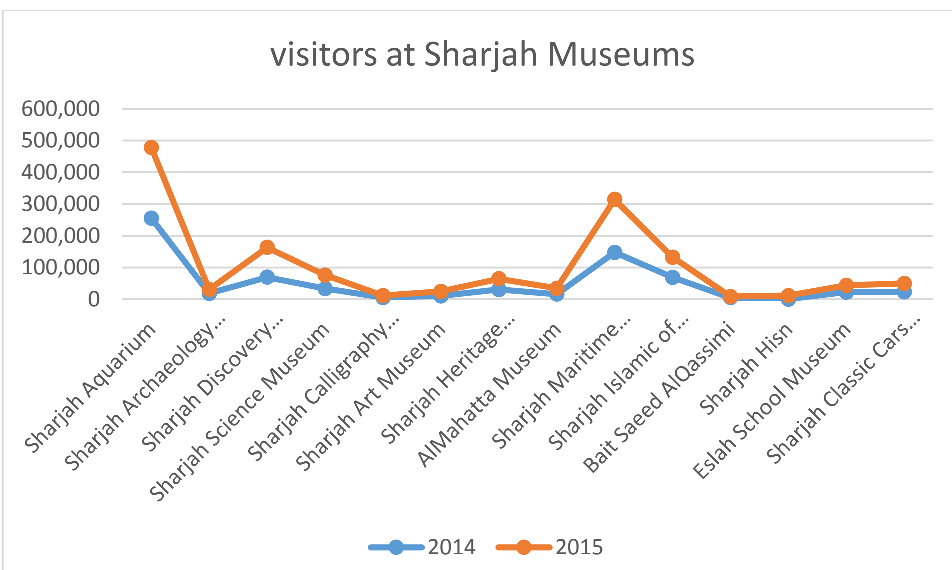


Figure 3.1: Number of Visitors at Sharjah Museums Authority (2014-2015)

In addition, Sharjah museums visitors' number in 2015 was more than 700,000 visitors. The number of visitors differed in different categories of visited to Sharjah Museums. These differences raised the need of finding more creative ways to attract more audiences to the museums. The below chart presents the visitor's category. Figure 3.2 presents 6 categories of visitors based on their nationality and visitor type (Authority, 2016). The number of foreign visitors continued to be the largest category of all visitors. Moreover, different categories of visitors also meant that different age groups of visitors also visited the museums. Sharjah Aquarium has the largest number of visitors while Bait Sheikh Saeed bin Hamad AlQassimi has the lowest number of visitors. The previous information about the full number of visitors to the mentioned museums is not attached as a part of Sharjah Museum Authority confidentially clause.

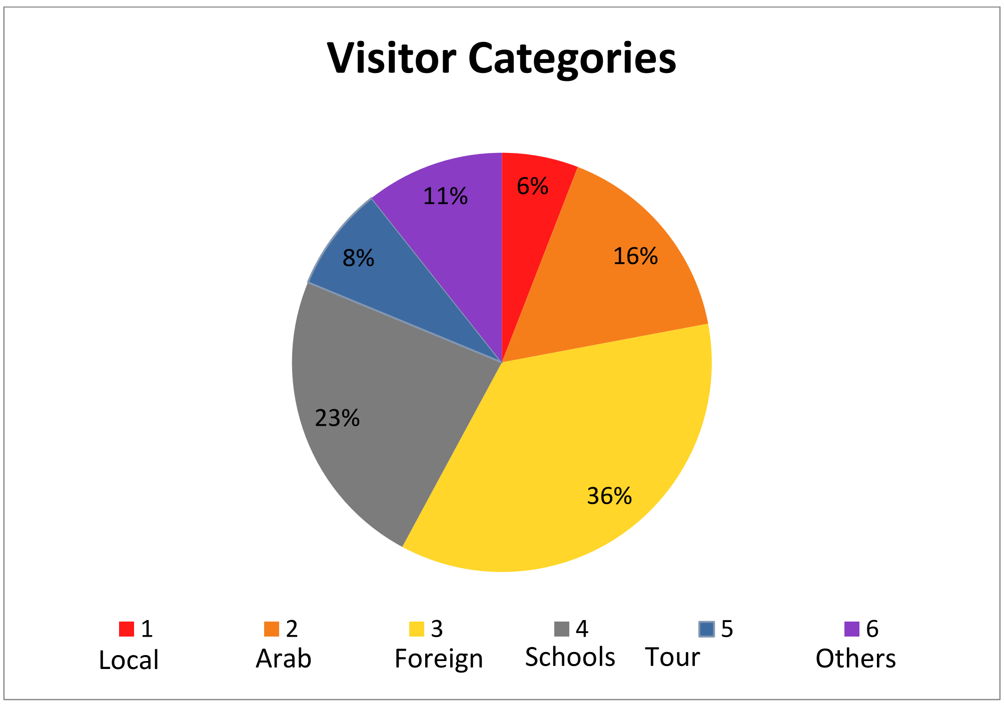


Figure 3.2: Visitors Category at Sharjah Museums Authority, 2016

To sum up, we can see that UAE museums are trying their best to be a state of the art, up-to-date with technology organizations. There is no doubt that these museums contain valuable historic collections and knowledge within their walls. And it's disheartening to see that the only means of viewing those collections online is via basic websites that do not do juice to the artifacts and does not display full information about them either.

Nowadays, the public and museum goers are seeking more than these basic information, they are looking for more detailed information about the collections as well as the fun of interacting with those items up-close.

## 3.5 Survey Structure

The questionnaire has been designed based on the hypothesis requirement, in order to collect more information and data about the visitors and their perspectives about UAE museums. The survey prepared and organized by the researcher of the study. The survey is also linked with the UAE Museums case study in order to examine the case limitations. The survey is prepared in English in order to allow more people from different educational levels and ages to understand it and answer the questions. The details of the survey is discussed in the rest of this section.

### 3.5.1 Visitors Interests to museums Survey

The visitors' interests to museums questionnaire includes 12 questions. The survey is divided into three sections. Appendix B illustrates a sample of the survey page.

The first section of the survey contains (5 items) that represent the visitors' personal information including: age, gender, nationality, residency and emirate.
The second section contains (4 items) that represent the visitors' interests and satisfaction of visiting museum. Table 2 demonstrate a summary of section 2 items.

| # | **Item description** |
|---|---|
| 6 | How often do you visit museums? |
| 7 | What mostly attract you to visit a museum? |
| 8 | In your opinion, Does marketing campaign presenting UAE museums enough? |
| 9 | If you have a chance to view museums' collections online, would this increase your interest to visit the museums? |

**Table 2: visitors information regarding visitors interests and satisfaction**

The third section of the survey contains (3 items) that represents the people opinion on the impact of technology in museums on visitors. Table 3 presents the summary of section 3 items.

| # | Item description |
|---|---|
| 10 | Do you think use technology at museums can increase number of visitors? |
| 11 | Do you think virtual museums can raise local interest to visit museums? |
| 12 | Is virtual museums way to market more than educate? |

**Table 3: Technology impact on museums' visitors**

## 3.6 Summary

In the previous chapter, the researcher have explained the methodology of this research alongside a case study about the UAE museums was discussed plus the questions of the "visitors' interests to museums" survey have been highlighted.

The researcher have concluded that applying virtual technology to UAE museum will increase the number of visitors to those museums, in addition this technology will raise the local interests and spread awareness about the museums and their collections.

The methodology used by the researcher in this study were qualitative and quantitative methods. Since it's based on case study and the use of a conducted survey. The case study data have been collected from different museum staff across UAE plus the researcher own observations. Moreover, 186 people have answered the survey (n=160 are local, and n= 36 are non-locals)

# Chapter 4: Analyzing and Discussion

*This chapter will discuss the findings of the research by analyzing the collected data. The chapter will also present the means of analyzing the qualitative method (Case Study) and quantitative method (visitors' interests to museums survey). The dependents and independents variables are demonstrated. Furthermore, the research questions have been answered.*

## 4.1 Case Study Analysis

The above information from the research about the history of museums and the UAE museums review, we can notice that the UAE has good number of museums as well as technological possibilities. The findings can be summarize in some points as follows:

- **Foreign visitors exceed the local visitors**

The statistics show that most of the museums visitors are foreigners. Which means that most of the visitors are either tourists or UAE foreign Residence. Whereas the lowest number of visitors were the UAE locals. This information has already been illustrated in the figure 3.2 above, these results show that there is not much interest from the locals to visit UAE museums, because the events and exhibitions not promoted properly in a way that will attract more visitors especially the locals. However, the museums are working hard to better their promotions and advertisements throughout most mediums of media outlets and online websites to attract more visitors from all museum visitors' categories especially the locals.

- **The Nonexistence of Mobile applications**

Despite the remarkable technology advancement in UAE organizations, powered by the directives and instruction of H.H. Sheikh Mohammad Bin Rashid AlMaktoum to transfer all services from manual to electronic, we still find that UAE museums have not built or develop any strong dependable mobile application for the public.

As the researcher was conducting a thorough search about the developments of museum applications in the UAE, no official authorized application was found, however, after searching for some time the researcher did find one lone unofficial application available for UAE museums on Apple app store, which was “Museum UAE.” This application presents only the location and the map direction to museums all over the UAE. The application does not include any further information about the museums or their collections and objects showcased, moreover, the application does not give a clear guidance or instruction on how to be use.

The digital marketing report for 2016 done by “We Social” network presented statistics about the internet and mobile penetration in UAE. Figure A.2.3 is presented in Appendix A. The statistics shows that the United Arab Emirates holds the first position in the world in internet penetration in January of 2016. These statistics represents the growth of mobile commerce and usage in the UAE. Moreover, the statistics showed that 62% of users used their mobiles for watching videos, 41% of the users used their mobiles for playing games and 71% used their mobile devices for social communication as presented in Figure A.2.4 in Appendix A. This indicates that the UAE public are technology savvy, and they like to spend time on their mobile devices, museums should study and take advantages of those statistics and start building applications and create a stronger online presence in order to gain more audiences (A., 2016).

- **Traditional show cases use to present the collections**

Most museums throughout UAE are still using the traditional glass showcases only, although other museums have started to gravitate toward showcasing their collections virtually and using interactive technology methods to attract museums goers. Although, different applications and technologies are available to digitalize the artifacts and exhibitions those few museums still have not tapped into the digital potential of virtualizing their objects and are still sticking to the limited glass showcases method, where the museum goer can only view the object without an up-close interaction and clear life like view.

## 4.2 Visitors Interests to Museums Data Analysis

The researcher has created the survey online and distributed the survey link among random people via different social media tools. The survey was divided into three sections: Personal information section, visitors’ interests and satisfaction section and mobile technology section. 186 people answered the survey (n=160) are local, and (n= 36) are non-locals and they are from different age groups, the most responses were from Abu Dhabi., while the lowest responses were from Um AlQawain.

### 4.2.1 Visitors Personal Information

Table 4 contains the summary of the personal data collected by the survey. The percentage of the UAE Locals who participated in the questionnaire was 80.65% while the non-locals were only 19.35%. The ages of the participants varied. Most of the responses were from ages between 25 and 34 as they were 39.25% of the total, while only 1.61% were older than 55. On the other hand, 95.16% of the participants were foreign UAE residence, and only 4.84% were tourists visiting the country.

| # | Questions | Answers | Frequency | Percentage % |
|---|---|---|---|---|
| 1 | What is your gender? | Male | 68 | 36.56% |
| | | Female | 118 | 63.44% |
| 2 | What is your age? | 15-24 | 41 | 22.04% |
| | | 25-34 | 73 | 39.25% |
| | | 34-44 | 66 | 29.57% |
| | | 45-54 | 14 | 7.53% |
| | | Older than 55 | 3 | 1.61% |
| 3 | What is your Nationality? | Local | 160 | 80.65% |
| | | Non-Local | 36 | 19.35% |
| 4 | What is your Residency? | UAE Residence | 177 | 95.16% |
| | | Tourist | 9 | 4.84% |
| 5 | In which Emirate of UAE do you live/stay? | Abu Dhabi | 66 | 35.48% |
| | | Dubai | 62 | 33.33% |
| | | Sharjah | 37 | 19.89% |
| | | Ajman | 8 | 4.30% |
| | | Um AlQawain | 2 | 1.08% |
| | | Ras AlKhaima | 6 | 2.69% |
| | | Fujairah | 6 | 2.23% |

**Table 4: Participant Personal Data**

### 4.2.2 Visitors' Interest and satisfaction information

The visitors interest in museums in general and their satisfaction level is illustrated in Table 5. 56.45% of the participants indicated that they rarely visit museums while the other 27.96% agreed that they never visit any museums. However, only 15.59% of the participants specified that they always visit museums. more to say, 41.40% of the people visiting museums went for the history and the historical stories while the other 13.98% visited the museum to inspect the technology used in showcasing the collections. And 14.52% of the participants went to the museums for the museum's events and exhibitions.

| # | Questions | Answers | Frequency | Percentage % |
|---|---|---|---|---|
| 6 | How often do you visit museums? | Always | 29 | 15.59% |
| | | Never | 52 | 27.96% |
| | | Rare | 105 | 56.45% |
| 7 | What mostly attract you to visit museum? | Museum's Location | 21 | 11.29% |
| | | Museum's Collection | 35 | 18.82% |
| | | Museum's Story & History | 77 | 41.40% |
| | | Museum's Event | 27 | 14.52% |
| | | Technology Used | 26 | 13.98% |
| 8 | In your opinion, Does marketing campaign presenting UAE museums enough? | Yes | 49 | 26.34% |
| | | No | 91 | 48.92% |
| | | No idea | 46 | 24.73% |
| 9 | If you have a chance to view museums' collections online, would this increase your interest to visit the museums? | Yes | 98 | 52.69% |
| | | No | 20 | 10.75% |
| | | Maybe | 68 | 36.56% |

**Table 5: Visitors' Interests and Satisfaction Data**

### 4.2.3 Technology in Museums

The technology used by museums is demonstrated in Table 6. 88.17% of the participants saw that the use of technology in museums can increase the number of museums goers, while only 11.83% saw that the use technology in museums has no impact on the number of visitors. Moreover, 87.63% of the participants responded that the use of virtual museums could raise the local interest to visit museums, whereas 12.37% responded that the use of virtual museums has no influence or impact on raising the local interest to visit museums.

| # | Questions | Answers | Frequency | Percentage % |
|---|---|---|---|---|
| 10 | Do you think use technology at museums can increase number of visitors? | Yes | 164 | 88.17% |
| | | No | 22 | 11.83% |
| 11 | Do you think virtual museums can raise local interest to visit museums? | Yes | 163 | 87.63% |
| | | No | 23 | 12.37% |
| 12 | Is virtual museums way to market more than educate? | Agree | 78 | 41.94% |
| | | Somehow | 91 | 48.92% |
| | | Disagree | 17 | 9.14% |

**Table 6: Technology in Museums' Information**

## 4.3 Statistical Analysis

A statistical analysis method has been used to designate whether there are any significant differences between the dependent and independent variables. The Statistical Package for the Social Sciences (SPSS) software was used to analyze the data and show the co-relation between the testing and the hypotheses.

### 4.3.1 The Dependent and Independent Variables

The dependent and Independent variables of this study are demonstrated in Table 7. The independent variables represent the combination of the personal items related to the participants' of the questionnaire interest when it comes to visiting museums and the challenges that face museums when implementing such technologies as discussed in the case study. Each research question has a related variable to the questionnaire items and the conducted case study.

| Research Questions | Independent Variables | Dependent Variables |
|---|---|---|
| **RQ1:** Is applying virtual technology in UAE museums will raise the Local interest? | Nationality | Virtual Technology (Survey items) |
| **RQ2:** Is applying virtual technology in the UAE museums will be a *challenge*? | Challenge | Virtual Technology (Case Study) |
| **RQ3:** Is applying virtual technology in UAE museums will attract visitors from different *Age groups*? | Age groups | Virtual Technology (Survey items) |
| **RQ4**: Is applying virtual technology in UAE museums will raise interest based on *Emirates*? | Emirates | Virtual Technology (Survey items) |

Table 7: Independent and Dependent Variables.

### 4.3.2 Research Questions' Analysis

**RQ1:** Is applying virtual technology in UAE museums will raise the Local interest?

To examine if there are any statistical significant differences among the Locals and non-locals interest in Virtual technology, a t test was conducted. Table 8 demonstrates the results of mean values for local and non-locals visitors which shows that there is not much difference among the two variables. The computed value of t is (0.253) and the significance level is ($p$ = 0.608, $p > 0.05$). Therefore, According to these findings the hypotheses have been proven, applying technology will raise the local interest in visiting museums.

| | Nationality | N | Mean | Std. Deviation | t | df | Sig. |
|---|---|---|---|---|---|---|---|
| Virtual Technology | Local | 150 | 1.13 | .334 | .253 | 184 | 0.608 |
| | Non-Local | 36 | 1.11 | .319 | | | |

Table 8: different between visitors interest based on their Nationality

**RQ2:** Is applying virtual technology in the UAE museums will be a challenge?

The answer to the above question is yes, since it was discussed in the case study above, there are several challenges that UAE museums will face when applying virtual technology, such as, catering to the different categories of visitors, the efforts and the resources that will take to showcase the collections and exhibits virtually. And the technological challenges that lies in keeping up with the ever changing technology world and lastly the efforts and the resources that's needed to gather the research documents along with the historical documents from different places and trying to bring them all together under one digitalized database and then displaying them to everyone virtually.

**RQ3:** Is applying virtual technology in UAE museums will attract visitors from different *Age groups*?

To determine if there is any significant difference among the visitors interest to virtual technology in term of age groups, univariate analysis of variance was used to calculate the mean and the standard deviation as demonstrated in Table 9. Moreover, one-way ANOVA was used to calculated and examine the differences between the mean scores as shows in Table 10. The findings of the calculation demonstrates that ($p = 0.450$, $p > 0.05$) which means that the hypotheses is accepted.

| Age | N | Mean | Std. Deviation |
|---|---|---|---|
| 15-24 | 40 | 1.12 | .335 |
| 25-34 | 74 | 1.15 | .358 |
| 35-44 | 55 | 1.11 | .315 |
| 45-55 | 14 | 1.00 | .000 |
| older than 55 | 3 | 1.33 | .577 |
| Total | 186 | 1.12 | .330 |

Table 9: Means and Standard deviation for visitors interest in term of their Age

| | Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Between Groups | .404 | 4 | .101 | .925 | .450 |
| Within Groups | 19.752 | 181 | .109 | | |
| Total | 20.156 | 185 | | | |

Table 10: ANOVA results for visitors interest to museums in term of Age

**RQ4**: Is applying virtual technology in UAE museums will raise interest based on *Emirates*?

To decide if there is any significant different among the visitors interest to virtual technology in term of Emirates, univariate analysis of variance was used to calculate the mean and the standard deviation as demonstrated in Table 11. Moreover, one-way analysis of variance ANOVA was calculated to examine the differences between the mean scores as shown in Table 12. The findings of the calculation demonstrates that ($p$ = 0.500, $p$ > 0.05) which means that the hypotheses is accepted.

| Emirate | Mean | Std. Deviation | N |
|---|---|---|---|
| Abu Dhabi | 1.11 | .315 | 64 |
| Dubai | 1.13 | .333 | 64 |
| Sharjah | 1.14 | .347 | 37 |
| Ajman | 1.13 | .354 | 8 |
| Um AlQuwain | 1.00 | .000 | 2 |
| Ras Alkhaimah | 1.00 | .000 | 5 |
| Fujairah | 1.17 | .408 | 6 |
| Total | 1.12 | .324 | 186 |

Table 10: Mean and Standard Deviation for visitors interest in terms of Emirates

| | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Between Groups | .587 | 6 | .098 | .894 | .500 |
| Within Groups | 19.569 | 179 | .109 | | |
| Total | 20.156 | 185 | | | |

Table 11: ANOVA results for visitors interest to virtual technology in term of Emirates

## 4.4 Conclusion

In this chapter, the collected data has been analyzed using the SPSS software. The case study analysis has been discussed and all challenges have been explained. Moreover, the questionnaire sections were also demonstrated, which were: the participants' personal information, the participants' interests in museums and the participants' point of view regarding applying technology in museums. Both the dependent and the independent variables were illustrated and an explanation of how they were examined was shown. The research questions were tested using different methods and the results of those tests supported the findings of the researcher. The final result of the analysis shows that all hypotheses have been accepted and proved.

# Chapter 5: Conclusion and Recommendations

## 5.1 Conclusion

In conclusion, technology nowadays can be found is every aspect of our daily lives, therefore, all organizations no matter big or small around the world are trying to incorporate technology one way or another into their businesses, and museums are not that far behind. it is been noticed that museums all over the world have been working hard to integrate technology into their operations to reach more audiences and to improve their services of showcasing their valuable artifacts and exhibitions in the best ways possible, so they can enrich both the culture and the society in the UAE and around the world in general.

Therefore, adding virtual technology will surely advance such endeavors. As the researcher discussed, the success of such experiments in the international museums were huge and this will surely be a great blue print in which UAE museums can go by and learn from. As mentioned above, the UAE has a technology savvy public that can benefit from such advancements in museums technologies which will ultimately attract more visitors as shown and proven by the survey that was conducted by the researcher.

And it can be observed in the literature review that the history of the museums goes back to the 18$^{th}$ century, people were always fascinated by historical events, locations and objectives. Therefore, coming to this century this fascination have not lessened and virtual museums is the futuristic way to go. As it can be seen in the literature different virtual technologies were used and tested to bring the museums to the 21th century. In addition, the challenges of improving museums' services and implementing such virtual technologies were demonstrated. Alongside some museums' successful experiments with virtual technology to test the visitors' satisfaction rates which resulted in intriguing the interest of museums goers.

In order to get a full view of the whole situation about the UAE museums and the technologies used by them at the present day, the researcher conducted a case study together with a questionnaire to prove their hypothesis. The case study demonstrated the existing challenges and the services offered by UAE museums. And the questionnaire was distributed among 186 participants using social media and was answered by 160 of UAE locals from different Emirates and different age groups. Both research methods have been analyzed and scrutinized in details above.

All the findings showed that the people are very interested in applying and implementing advanced technology in museums around the UAE, which will eventually raise the number of total visitors as well. The RQ1 proved that implementing virtual technology will raise the local interests of museums goers in the UAE. 150 locals agreed that their interest will increased in UAE museums by the addition of some type of technologies to them. RQ2 explained the challenges faced by the museums while applying new project and these findings were via the case study conducted in UAE museums. RQ3 proved that different age groups are looking forward to having virtual technologies in UAE museums. The highest age group that agreed that having technology will increase their visitation frequency to the museums was the group between 25 and 34 years old which equals 39.25% of the total result. RQ4 demonstrated that Abu Dhabi and Dubai residences are seeking the advancement of virtual technology in UAE museums, since the number of responses showed a slight difference between both Emirates with Abu Dhabi responses being 66 and Dubai responses being 62.

Generally, the discussed results indicates a huge interest in applying virtual technology in the country’s museums which will lead to an increase the local inserts and the visitation frequency UAE museums. Therefore, the researcher is an avid supporter that museums in the UAE start to incorporate technologies into their operations.

## 5.2 Recommendations

- **Applying virtual technology in UAE museums**

It is recommended that the UAE museums start thinking of implementing virtual technologies for various reasons, some which include reaching a wider audience through online presences and another for the necessity of keeping record of the demolished historical buildings around the country, especially after the urban development’s boom in the country. Moreover, creating online virtual exhibitions that can be accessed by visitors virtually will contribute in promoting UAE museums for the locals as well tourists from around the world which will help in increasing the number of museums goers.

- **Applying E-visitor system**

Since UAE museums depend on counting the visitors by the number of purchased tickets at their ticket booths, for their yearly museum statistics. A new systems must be applied when they choose to go virtual. This new ticketing system will account the virtual visitors as well, and this will boost the museum yearly statistics. Virtual museums or virtual exhibitions are created online via websites and/or online application. The idea is to offer the public an online E-ticket to gain access to the virtual exhibitions and collections and later combine the number of those purchased e-tickets with the tickets purchased at the booth for more accurate yearly statistics.

- **Understanding visitors' requirements**

It is recommended that museums in the UAE keep conducting studies and researches of the UAE public to better understand their requirements and what is it they would like to browse in the country museums. It is important to keep working alongside them in order to improve the services as well as the technological services that the UAE museums offer.

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# Appendix A: Case Study Materials

## A.1: Interview Questions

Interview Notes Form

Interview Details

| | |
|---|---|
| Date: ________________________ | Time: ______________________________ |
| Name: ________________________________ | |
| Job title: ______________________________ | |
| Museum Name: ________________________ | |

Questions to Ask

1 What kind of artifacts and collections are display in Dubai Museum?

2 How do display the collections?

3 What is the technology use in the museum?

4 How many media screens are available at museums?

5 What are the new projects at museums?

6 Is there any project to apply any mobile application or virtual museum?

7 What are the visitors' category at museums?

8 What are the number of visitors monthly?

9 How can you attract and increase the number of visitors?

10 In your opinion, why locals do not visit museums?

Additional Notes

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## A.2: Additional Figures

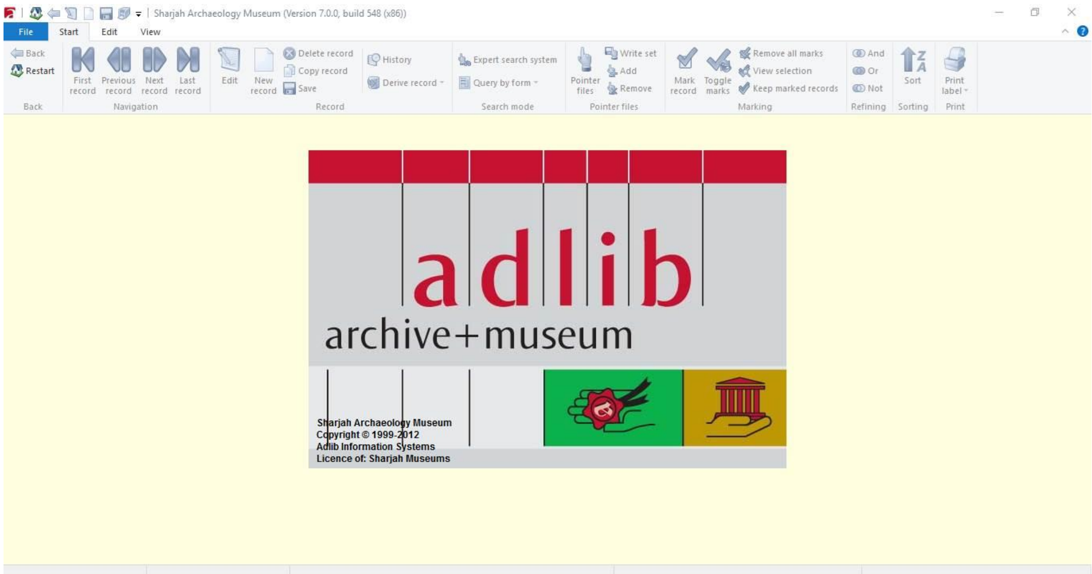


Figure A.2.1: ADLIB Application Main Page by Sharjah Museums Authority

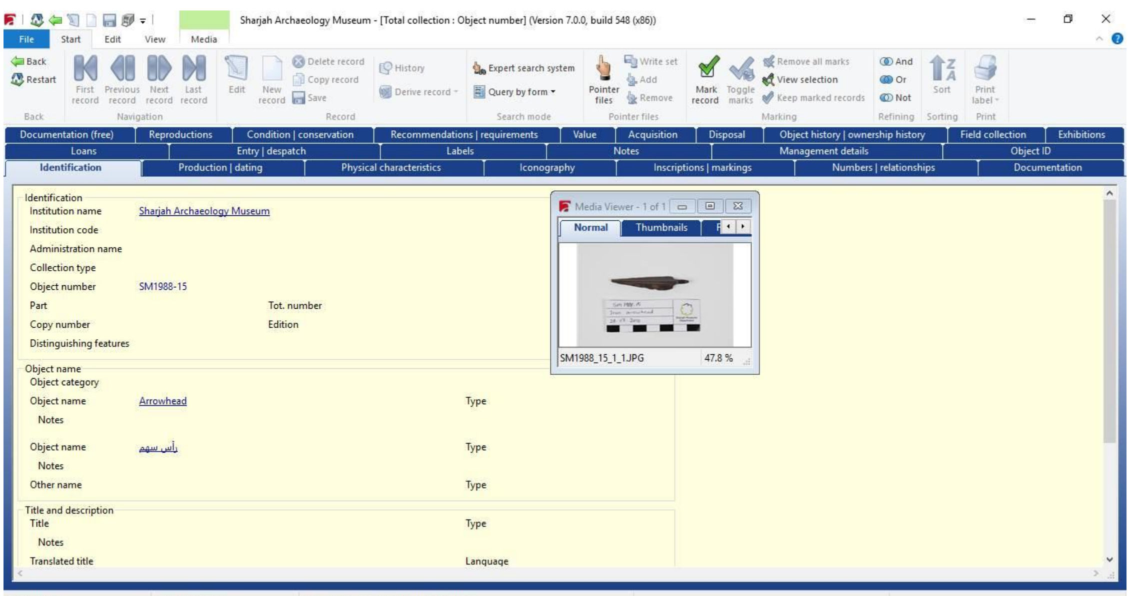


Figure A.2.2: Example of Museum object record by Sharjah Museums Authority

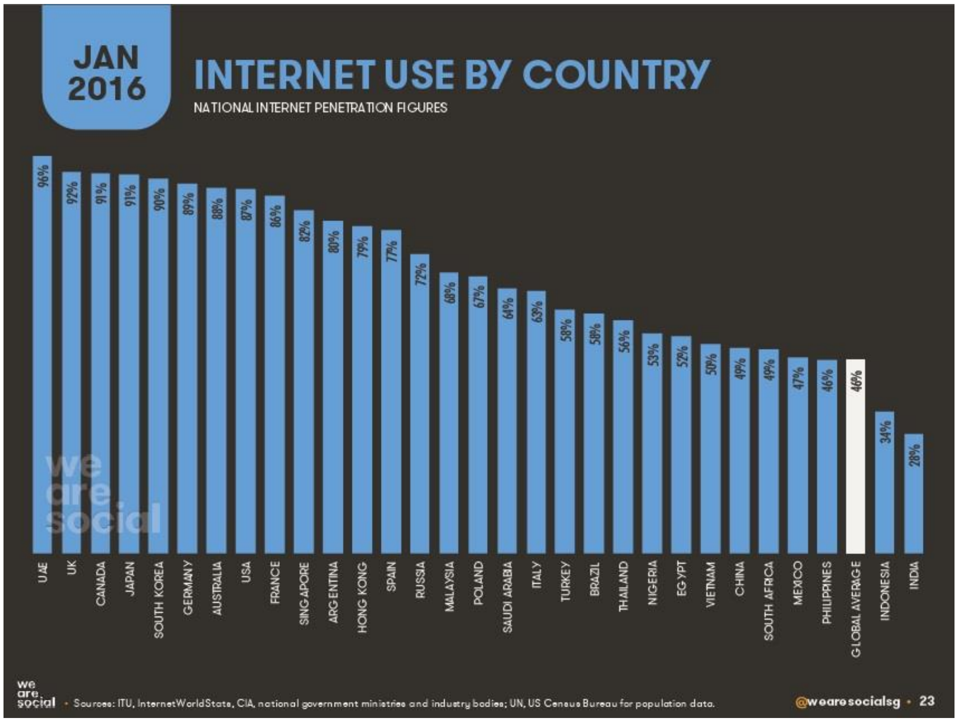

Figure A.2.3: Internet Use by Country by Social Media, 2016

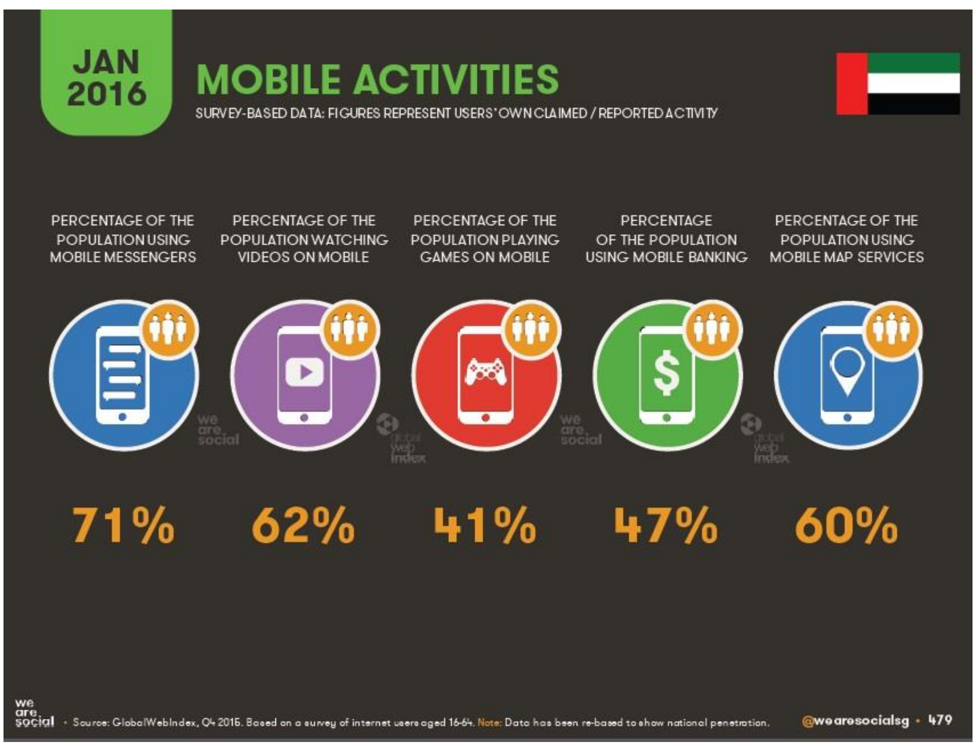

Figure A.2.4: Mobile Activities in the UAE by Social Media, 2016

# Appendix B: Survey

## B.1: Visitors interests to museums

Welcome to the Visitor Interest to Museums Survey.

Thank you for agreeing to take part in this Survey which is examining the local interests and visitors opinions about virtual museums for educational research. Virtual Museums **is** a collection of electronic artefacts and information resources - virtually anything which can be digitized.

The Survey will take 4-5 minutes to complete. Please be assure that all answers will be confidential.

| **Part#1: Personal Information** | | | |
|---|---|---|---|
| 1 | What is your Gender? | | |
| | ○ Male | Female | |
| 2 | What is your Age? | | |
| | ○ 15-24 | ○ 25-34 | |
| | ○ 35-44 | ○ 45-54 | ○ Older than 55 |
| 3 | What is your Nationality | | |
| | ○ Local | ○ Non-Local | |
| 4 | What is your Residency? | | |
| | ○ UAE Residence | ○ Tourist | |
| 5 | In which Emirate of UAE do you live/ Stay ? | | |
| | ○ AbuDhabi | ○ Dubai | |
| | ○ Sharjah | ○ Ajman | |
| | ○ Um AlQawain | ○ Ras AlKhaimah | |
| | ○ Al-Fujaira | | |
| **Part#2: Visitors Interests and Satisfaction** | | | |
| 6 | How often do you visit museums? | | |
| | ○ Always | ○ Never | ○ Rare |
| 7 | What mostly attract you to visit a museum? | | |
| | ○ Museum Location | ○ Museum Story & History | ○ Museum's Collections |
| | ○ Technology Used | ○ Museum Events | |
| 8 | In your opinion, Does marketing campaign presenting UAE museums enough? | | |
| | ○ Yes | ○ No | ○ No Idea |
| 9 | If you have a chance to view museums' collections online, would this increase your interest to visit the museums? | | |
| | ○ Yes | ○ No | ○ Maybe |
| **Part#3: Technology in Museums** | | | |
| 10 | Do you think use technology at museums can increase number of visitors? | | |
| | ○ Yes | ○ No | |
| 11 | Do you think virtual museums can raise local interest to visit museums? | | |

| | | | |
|---|---|---|---|
| | ○ Yes | | ○ No |
| 12 | Is virtual museums way to market more than educate? | | |
| | ○ Agree | ○ Somehow | ○ disagree |