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MIDDLE EAST UNIVERSITY
Amman - Jordan

The Impact of using Internet of Things on Quality of Service in Royal Jordanian Airline from Passengers Point of View

أثر أستخدام إنترنت الأشياء على جودة الخدمة في الملكية الأردنية من وجهة نظر المسافرين

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Thesis Submitted in Partial Fulfillment of the Requirements for Master Degree in E-Business.

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Authorization

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Thesis Committee Decision

The thesis of the student Hasan Abdallah Shkoukani, which studied "**The Impact of using Internet of Things on Quality of Service in Royal Jordanian Airline from Passengers point of view**", has been defined, accepted, and approved on 14th of May 2019, by the following committee members:

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The Researcher

Dedication

I dedicate this thesis to my parents who instilled patience in me and raised me to be the person I am now.

Thank you for everything you have done for me.

To my beautiful wife and gorgeous Daughter I also dedicate this for you both and thank you for being in my life.

Last but not least, my brothers and sisters, this is also yours and i thank you all for your support

Yours Hasan

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The Impact of using Internet of Things on Quality of Service in Royal Jordanian Airline from Passengers Point of View

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Abstract

The aim of this study is to investigate the impact of using internet of things on quality of service in Royal Jordanian Airline from passengers point of view. The methodology used to get viable outcomes is descriptive analytical approach through collecting and classifying data received from 378 respondents. Data gathered from passengers whose using Royal Jordanian mobile application and self-check-in at Queen Alia International Airport and Royal Jordanian Sales Offices. For this purpose, questionnaire was prepared and distributed to the targeted samples. Afterwards, statistical and analytical statistical methods were used to reach the result.

The major result of this study showed that there is a significant impact of using IoT (Intelligence, Connectivity, Dynamic Nature, Enormity, Sensing, Diversity and Security) on quality of service in Royal Jordanian Airline from passenger's point of view.

The study recommends that Royal Jordanian airline should focus on the aspects of IoT that been developed and confirmed during this study to have impact on quality of service, by setting of applications through which they present a service with quality which will help to attract more customers.

Keywords: Internet of Things, Quality of Service, Royal Jordanian, Mobile application

أثر استخدام إنترنت الأشياء على جودة الخدمة في الملكية الأردنية من وجهة نظر المسافرين

إعداد:

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محمد جميل العضايلة

الملخص

هدفت هذه الدراسة إلى تقصي أثر إستخدام إنترنت الأشياء على جودة الخدمة من وجهة نظر مسافري الملكية الأردنية، وقد تم إستخدام المنهج الوصفي التحليلي للحصول على النتائج وذلك من خلال جمع المعلومات وتصنيفها حسب ورودها من عينة الدراسة للمسافرين الذين يستخدمون تطبيقات الهاتف النقال الخاص بالملكية الأردنية واجهزة التشييك الذاتي في مطار الملكة علياء ومكاتب مبيعات التابعة للملكية الأردنية.

ولهذه الغاية تم إعداد إستبيان إستقصائي وجمع 378 استجابة صالحة للتحليل وأستخدمت الاساليب الاحصائية الوصفية والتحليلية للوصول الى النتائج.

خلصت الدراسة إلى عدّة نتائج كان من أهمها ان هناك أثرإستخدام إنترنت الأشياء (الذكاء، الاتصال، الطبيعة الديناميكية، الضخامة، الاستشعار، التنوع والأمن) على جودة الخدمة في الملكية الأردنية من وجهة نظر المسافرين.

توصي الدراسة بأن على الملكية الأردنية التركيز على جوانب إنترنت الأشياء التي تم تطويرها وتوكيدها خلال هذه الدراسة والتي تؤثرعلى جودة الخدمة، من خلال إعداد التطبيقات التي تقدم من خلالها خدمة ذات جودة تساعد على جذب المزيد من العملاء.

الكلمات المفتاحية: إنترنت الأشياء، جودة الخدمة، الملكية الأردنية، تطبيقات الهاتف النقال.

Chapter One

General Framework

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Chapter One

1.1 Introduction

The Internet of Things (IoT) is a notion that ensued in the technical world to add comfort to our life and make it easier. Now days, the internet has become a pivotal part in people's life. It can be portrayed as the genuine bases of amalgamation between comfort and the internet per se. This is by far the notion IoT. Industrial internet is a hot discussion in the industrial world. It aims to empower industries with sensors, software and analytics to manufacture more advanced and brilliant machines. The major advantages of this will be quality control, sustainability, goods tracking and real time information exchange.

IoT is a network of physical devices connected to each other that enables an easy exchange of data and information by the means of particular sensors and actuators. These actuators and sensors are embedded on to these devices which allow them to exchange data with each other and come up with an ideal connection with the internet. The 'things' here refer to internet of things devices like chips, cameras, sensors or such other physical devices (Madakam, et.al., 2015).

The aviation world witnesses an immense spread and progress. It has become a crucial, necessity for this field to rely and adopt the newly emerged technologies .As such, almost, if not all airlines corporations have come to depend on technology to maintain and obtain all the factors of excellence. As the Internet of thing , in its all parts , either applications or objects , is widely used in airlines business ,this research will tackle and touches upon its positive impacts on the airline industry in general and its reflections on the quality of services for Royal Jordanian Airline in specific (Alur, et.al., 2016).

This study focuses on IoT (Royal Jordanian mobile application and self check-in) and its impact on quality of service, as IoT can serve as a tool to minimize costs, both operational and technical (Lee & Lee, 2015). Using IoT helps to decrease the number of staff needed, the Services Counters and some facilities in the airport (Perera, et.al., 2013). Saving the customers' time and efforts through using the IoT (Palattella, et al.,2016). As an example, passengers can refer to the Royal Jordanian (RJ) application and obtain the up-to-date information about flights (Pang, 2013). Using the IoT reflects the competitiveness and high performance of Royal Jordanian and expresses the quality of services (Zero waiting time), facilitate the travel procedures and punctuality in flights schedule presented. (Trappey, et.al., 2017). This study is sought to investigate impact of using IoT technologies in the airlines companies which will ultimately reflect the positively on the services they render. This study adopted the descriptive and analytical approach. Descriptive approach depends on literature review to build the conceptual frame work and probing the relationships between the study variables. Literature review extended to develop the questionnaire items. Analytical approach used to assure reliability for the measurement scale and testing the hypotheses and interpreting the results regarding the data collected. Data was collected to investigate the impact of using IoT on service quality in Royal Jordanian Airline. Results and recommendations will also be reported.

1.2 Study Problem

The IoT industry, over the recent years, expanded dramatically and became a core factor in any business and a crucial instrument for governmental bodies all over the world. This high spread led to a genuine and high competition among the businesses that every and each one of them strives to grab any chance to gain advantages and elevate in quality.

IoT aims to improve the quality of work and to facilitate businesses and people's lives. According to the researchers IoT have many advantages such as saving time, decreasing total costs, improving communication, improving quality of life and increasing the efficiency of automation (chen, 2017; Dimitrov, 2016). As such, this leads to an improved quality of the services adduced in all fields. The researcher notice a high use of IoT in many applications such as healthcare, wearable, smart home, connected car, smart city, industrial internet, smart retail and aviation as reported by many researchers (Zhu, et.al.,2015 ; Mohanty, et.al.,2016 ; Tripathi,2017).

As far as aviation use of IoT, the researcher noticed the huge dependence of airlines in the Middle East on technologies, what can be described as high tech equipped airlines. As an example to that would be found in aviation. With that being said, some problems seemed to be emerging and appearing in this field. This study sheds the light on the main short comings of the use of IoT in Royal Jordanian Airline.

The study detects the role of IoT in the quality of services presented. Within this context, the study highlights in the following: Some passengers tend to overlook IoT and stick to the fact that they are only labeled as loyal customers and some others lack the basic knowledge about the IoT as a concept. The inappropriate marketing of the applications of the company which make them idle and unknown to customers (Islam, et.al.,2010).

A lot of the internet of things applications hasn't yet matured enough in terms of being widely used and applied. Furthermore, the experimental studies that measure the main component elements of using IoT and its influence on the quality of services are few. Hence, many organizations, among which Royal Jordanian Airline, came to realize that it is rather difficult for

them to comprehend the expected advantages of using the IoT and measuring its impact on the quality of services they present to their customers.

As aviation business is considered one of the most important economic sectors that relentlessly strive to improve the quality of its services, this study aims to shed the lights on the main dimensions that forms the internet of things and the quality of services through developing suitable criteria to measure its impact.

"Is there any Impact of using Internet of Things on quality of service in Royal Jordanian Airline from Passengers point of view"?

1.3 Study Objectives

The thesis investigate the impact of using IoT on quality of service in Royal Jordanian Airline from passengers point of view, these objectives are:

- Developing a theoretical framework concerning the dimensions of the study.
- Develop a measurement scale for the study dimensions that characterized with validity and reliability.
- Investigate the impact of using IoT (Intelligence, Connectivity, Dynamic Nature, Enormity, Sensing, Diversity and Security) on quality of service in Royal Jordanian Airline from passengers point of view.
- Provide recommendations to decision-makers in Royal Jordanian Airlines to focus on the most important aspects of mobile applications, which help improve the quality of service.

1.4 Study Significance

Scientific significance

Over the past decade, the business and economy sectors went through many changes and alterations towards relying on IoT to make a foundation for its success and progress. Having to have this value , many researchers undertook studying the IoT and submitted theories and premises in it which will , consequently, enables the beneficiaries to get the most value in it.

IoT participate in thrive of any business, industry or any other field in life. The quality of service was focused and subject of content. No different than any other sector, aviation tends to exploits and employs the IoT to better its services and elevate in its value.

Applied significance

The researcher developed a conceptual model that includes the dimensions of the study from literature and ascertaining the characteristics of psychometrics such as validity, reliability of the measurement scale and fitting study model with the data collected from the study sample.

This thesis significance proved the impact of using IoT on quality of service in Royal Jordanian Airline. The study also focused on measuring the significant impact of the IoT on the quality of service. The empirical study is the basis for judging the dimensions of the IoT and the appropriate things that will be emphasized by the decision makers in the Royal Jordanian.

1.5 Study Questions and Hypothesis

Study Questions:

This study answered the below questions:

- What are the dimensions of IoT in Royal Jordanian?
- What is the dimension of quality of service in Royal Jordaian?
- What is the impact of using IoT on quality of service in Royal Jordanian Airline from passengers point of view?

Study Hypothesis:

This study aimed to test one main hypothesis and seven sub hypothesis according to the above questions and objectives, which show as following:

Main Hypothesis

- $H_0$1: There is no significant impact of using IoT with its dimensions (Intelligence, Connectivity, Dynamic Nature, Enormity, Sensing, Diversity and Security) on quality of service in Royal Jordanian Airline from passenger's point of view, at the level of significance ($\alpha \leq 0.05$).

Sub Hypothesis

- $H_0$1.1: There is no impact of using IoT Intelligence on quality of service in Royal Jordanian Airline from passenger's point of view at the level of significance ($\alpha \leq 0.05$).
- $H_0$1.2: There is no impact of using IoT Connectivity on quality of service in Royal Jordanian airline from passengers point of view, at the level of significance ($\alpha \leq 0.05$).
- $H_0$1.3: There is no impact of using IoT Dynamic Nature on quality of service in Royal Jordanian Airline from passengers point of view, at the level of significance ($\alpha \leq 0.05$)
- $H_0$1.4: There is no impact of using IoT Enormity on quality of service in Royal Jordanian Airline from passengers point of view, at the level of significance ($\alpha \leq 0.05$)
- $H_0$1.5: There is no impact of using IoT Sensing on quality of service in Royal Jordanian Airline from passengers point of view, at the level of significance ($\alpha \leq 0.05$)
- $H_0$1.6: There is no impact of using IoT Diversity on quality of service in Royal Jordanian Airline from passengers point of view, at the level of significance ($\alpha \leq 0.05$)
- $H_0$1.7: There is no impact of using IoT Security on quality of service in Royal Jordanian Airline from passengers point of view, at the level of significance ($\alpha \leq 0.05$)

1.6 Study Model

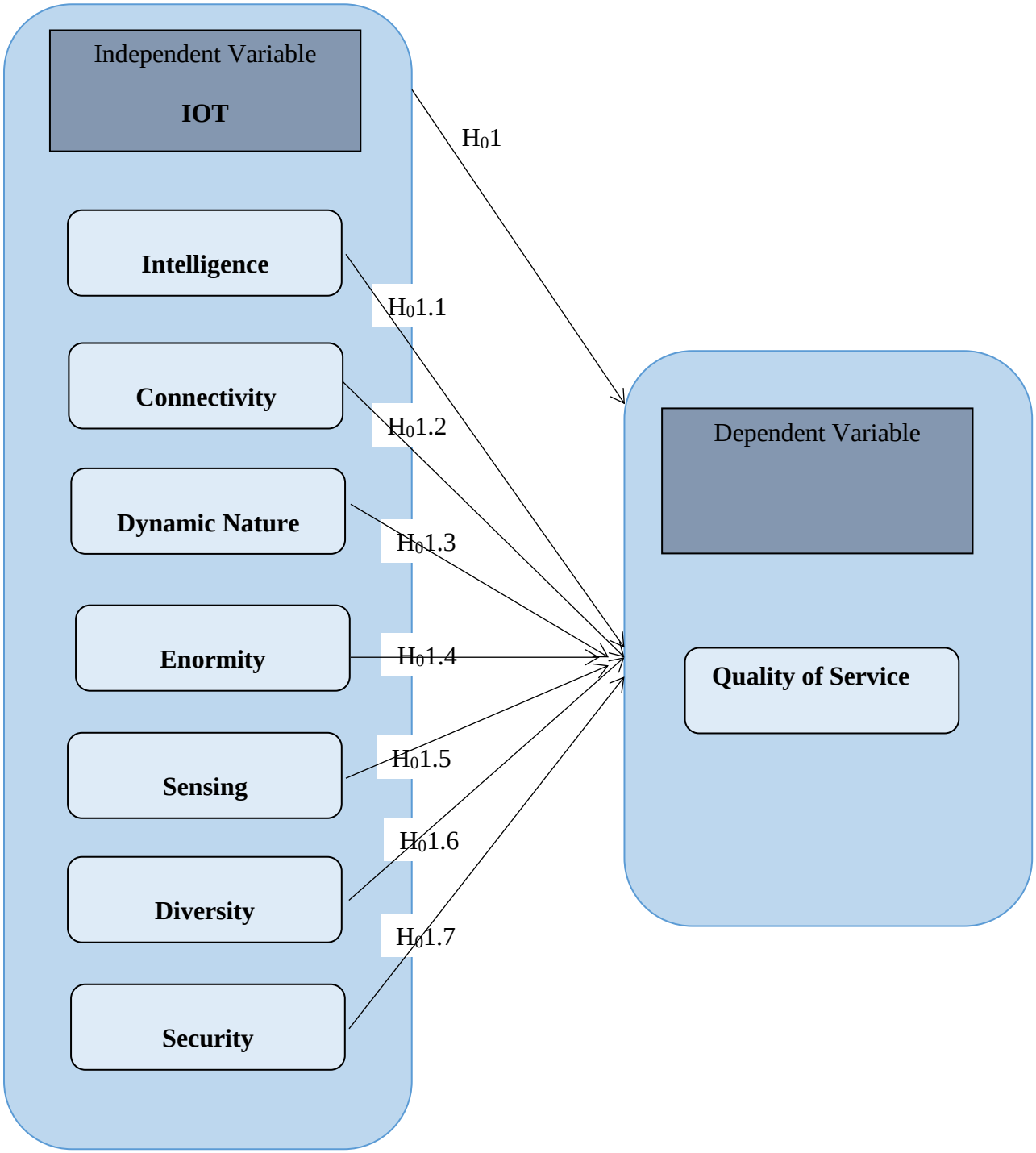

Figure (1-1): Study model.

This model adopted by several studies. The independent variable IoT and the dependent variable Quality of Service from passenger's point of view have many areas which are the most repeated in previous studies.

Sources: prepared by the researcher based on:

Independent variable: IoT based on studies of:

- Atzori, et,al.,(2010) The internet of things: A survey. Computer Networks.
- Li, et.al., (2015). The internet of things: a survey. Information Systems Frontiers.
- Gubbi, et.al., (2013) Internet of Things (IoT): A vision, architectural elements, and future directions. Future Generation Computer Systems.
- Farooq, et. al., (2015). A critical analysis on the security concerns of internet of things.
- Jara, et.al., (2013). The Internet of Everything through IPv6: An Analysis of Challenges, Solutions and Opportunities.
- Patel & Patel (2016). Internet of things-IOT: definition, characteristics, architecture, enabling technologies, application & future challenges.
- Dey & Mukherjee (2018). Towards Automation of IoT Analytics: An Ontology-Driven Approach.

Dependent Variable: Quality of Service based in studies of:

- (Simiscuk, et.al.,(2017) under the title "Performance Analysis of the Quality of Service aware Networking Scheme for Smart Internet of Things Gateways"

1.7 Study Limitations

There are number of limitations for this study:

- **Human limitation:** this study carried out with passengers travelling with Royal Jordanian Airline whose using mobile application and self-check-in.
- **Place limitation:** this study conducted at Queen Alia International Airport in Jordan and for Royal Jordanian passengers using RJ application and self-check in.
- **Time limitation**: the academic year 2019.
- **Scientific limitation:** this study will focus on determining the impact of using IoT on quality of service in Royal Jordanian airlines from passengers point of view and adapt the prior's studies recommendations.

1.8 Study Conceptual Definitions

Internet of things (IoT) : Over the past few years, the term internet of things IoT, a term related to Information and Communication Technology (ICT), has come to being due to the extensive dependence of many objects on the internet. Things being the objects, are tagged with a RFID transponder with a globally unique ID EPC (Electronic Product Code). The fact is that the IoT has a cyber-existence that connects physical objects or virtual things and makes them tools of exchanging data and information. This could be a piece of content, a service, or the representation of a physical object (Lee, et.al., 2013)

Intelligence: IoT is made up of a set of algorithms and computation, software & hardware that makes it smart. Ambient intelligence in IoT enhances its capabilities to stimulate the things respond in an intelligent way to a particular situation and supports them to perform the specified tasks. Despite the fact that smart technologies are widely spread and most popular, intelligence in IoT is only set to be a means of interaction between devices. Such interaction between user and devices is achieved by the standardized input methods and graphical user interface (Zhou, et.al.,2018)

Connectivity: Connectivity sparks the IoT to bring together everyday objects. It is the key element that IoT stands upon and without it devices cannot be connected to each other and operates as one unit and make them accessible, compatible networks. With this connectivity, new

market opportunities for Internet of things can be created by the networking of smart things and applications. (Samuel, S 2016)

Dynamic Nature: The major activity of IoT is to gather data from the surrounding environment adapting with dynamic changes happening around the devices and automatically their states dynamically becomes affected with changes, example high or low, connected and/or disconnected, their nature which includes temperature, location and speed. In addition to the state of the device, the number of devices also changes dynamically with a person, place and time (Taivalsaari, A., & Mikkonen, T. 2017)

Enormity: Enormity is the capability of a system, network, or process to handle a growing amount of work, or its potential to be enlarged in order to accommodate that growth. It is an absolute necessity for the success of the IoT. it not only expresses the high expand but also the ability to accommodate and adapt to contain the expected high growth in the use of IoT in life. Enormity is also a mega-phenomenon which is driven by smaller and more specialized processes. A very crucial aspect for enormity is the features that need to be kept in mind for enormity. These include features such as business, marketing, hardware, software and network.

(Corujo, et.al., 2011)

Sensing: Is a group of Sensors that detect or measure any changes in the environment to generate data to report on their status and interact with the environment. Sensing technologies provide the means to create capabilities to both interact with objects and users. The sensing information is simply the analogue input from the physical world providing a rich understanding of our complex world. (TongKe, F. 2013).

Diversity: Refers to the rang of different things that are related to IoT in terms of the services provided through it and the multiplicity of applications involved as well. The diverse nature of the IoT applications enables the end user to gain the utmost benefit of it as they can resort to it for the different services he asks for in any time and any place (Patel & Patel 2016).

Security: The security issues of IoT can be largely divided into two types; Technological issues and Security issues. The technological issues grow due to the heterogeneous and ubiquitous nature of IoT devices, while the security issues are related to the principles and functionalities that should be enforced to achieve a secure network. Technological issues are typically related to wireless technologies, scalability, energy, and distributed nature, while security issues require the ability to ensure security by authentication, confidentiality, end-to-end security, integrity etc. Security should be performed in IoT throughout the development and operational lifecycle of all IoT devices and hubs (Mahmoud, et.al., 2015)

Quality of Service: An assessment of how well a delivered service conforms to the client's expectations. Service business operates often assess the quality of service provided to their customers in order to improve their service, to quickly identify problems, and to better assess customer satisfaction (park, et.al., 2016)

Chapter Two

Theoretical Framework and Previous Studies

2.1 Theoretical Framework.

2.2 Previous Studies.

Chapter Two

The following chapter reviewed the related literature and previous relevant studies that are related to Internet of things (IoT).

2.1 Theoretical Framework

This section includes many aspects observed through previous studies which are related to the IoT and quality of service and their dimensions as well.

The IoT is becoming a concept that most businesses and companies have come to realize its importance for them to elevate their competitiveness and improve the quality of the services they present. Also, customers consider IoT a part and parcel of their welfare an well- being as it makes the services available and attainable as well which ultimately makes their lives easier. There for, many literature reviewed the IoT aspects and highlighted its uses and benefits in all fields.

Zhu, J. (2017) studied the airline service quality performance and found that IoT gave the Airline companies many factors of success. They became aware that any application they use to make the life of a customer easy is one of the elements of marching the road of progress. The researcher also pinpointed and concluded that airline companies figured out that IoT is very important for their competitiveness and high performance. On the other hand Da Xu, et.al., (2014) found healthcare is an important application area of IoT to be adopted to enhance service quality and reduce costs. In a broader look, the study incite a larger inclination in the health care

sector, in its all fields , towards adopting the IoT which will ultimately reflects positively on the services presented and the general progress as well.

In another study, the researchers Uden & He (2017) concluded that businesses are forced to change their strategies and set new goals with having IoT as a significant part among its component. They also found the results that a large number of applications were being created every day to provide easier services and that are why knowledge must be automated.

Simiscuka, et.al., (2017) in their study found out that 25 billion devices are expected to be part of IoT networks by 2020. So much effort were being put in designing solutions to network so many devices while maintaining good quality for the diverse supported services

Whereas Islam, et.al., (2015) came to the fact that most important result in the study highlighted is that the health care resorted to the IoT to elevate its physical aspects and enhance its values as being in direct contact with human health.

Gong, W. (2016) found the outcomes of his study stated that the IoT and the Market space are closely connected. The IoT can classify markets and the advantages that it can gain from being technologically recognition.

While Park,et.al., (2016) inferred that IoT made the quality of service a human-centric and companies and businesses, accordingly, make quality assurance a significant part of their entities. For this reason, IoT, asp per this study, has become a subject of scrutiny and a required aspect in all domains.

In another related context, Tanganelli, et.al., (2018) came up with the result that the IoT reformed the processes and procedures in the companies and for the businesses, in a wide range,

in all fields and transformed them from personal to industrial. Hence, IoT systems are expected to be employed in a large number of use cases for heterogeneous applications.

Bhaddurgatte, et.al., (2015) In their study, summarized the outcomes of the service quality architectures and schemes derived and defined by various research communities and academic organizations and based them on the careful study and understanding of service components, enabling technologies, message / data classification, application domain areas, and interactions between each of these modules / components and that service quality parameters may be influenced by actions in other layers.

Another research by Li & Li (2017) concluded that after few years, 26 billion network-connected devices will be predicted to the IoT, enabling the monitoring of almost every device and human activity. For example, Cisco predicts the IoT boosts global corporate profits by twenty-one percent and its market is to be $19 trillion dollars (Kharif 2014).

Study dimensions:

This study focuses on using of IoT and its impact on quality of services in Royal Jordanian Airline, the study hypothesized that Intelligence, Connectivity, Dynamic nature, Enormity, Sensing, Diversity and Security are component of IoT which have their impact on quality of services.

Many studies and researches pointed that using the IoT has a huge impact on the quality of service in different fields and sectors of business. To clarify, the researcher Zhu, J. (2017) study on the Airline services quality performance suggested that the business should be in a direct contact with the users, being the customers, and that the main attribute in that context must be

the services the airline presents with quality. (Islam, et.al.,2015) in his study about the IoT for Health Care, highlighted that the IoT makes the objects technologically smart in order to aid in the foundation for the development of the cyber feature of it. That will get the health care sector, as it is a highly sensitive, to the required quality of services along with all the guarantees of success factors. The IoTs are devices and things that mainly hooked up with sensors. This sensing nature had and has positively made the health care sector better when it comes to saving lives and improving the health of humanity (Dimitrov,D 2016).

The main care and attention of the IoT and applications users are the quality of services. To celebrate any quality of services presented through applications - especially when it comes to personal information - security stands sold as this makes the users more relaxed and protected (Mahmoud, et.al., 2015).

Furthermore, the dimension of diversity has a reflection on the quality of services. The involvement of IoT in all fields made the users tend to resort to the applications for any service whatsoever. Also the diversity within the application itself makes the customer even more satisfied as he can find what he is looking for of services. This is the true essence of quality of service (Patel & Patel, 2016).

- **Intelligence:** Internet of Things is a combination of hardware and software along with complex algorithms and computations. It has certain capabilities that are supported with technological intelligence that enables it to act and react in light of the variable situations. (Gubbi, et.al., 2013)

- **Connectivity:** Connecting the objects with internet is the main merit of the IoT that pave the way of an easier march towards progress in life through making new market opportunities via creating accessible and compatible network of smart objects and applications. (Jara, et.al., 2013)

- **Dynamic Nature:** The IoT devices receive data from its surrounding environment and process it. However , this is influenced by the dynamic changes that take place around the devices leading to a dynamic adjustment to its nature , connected or disconnected , high or low temperature, speed , persons , place and time (Miorandi, et.al., 2012).

- **Enormity:** After few years, the connected devices to the internet will be greater than these days for communication. Indicated by statistics there are more than 5 million new devices are connected daily and increased up. (Atzori, et.al., 2010).

- **Sensing:** Sensors are the main object in IoT without it cannot derive the changes in the environment and measured. Data detected and collected by interacting with environment around. The inputs absorbed from the environment, issues the information that is detected by the sensor (Perera, et.al., 2014).

- **Diversity:** Diversity is the important factors of IoT. The IoT devices have different network and hardware platforms that they are able to connect with other devices through different networks. The IoT is able to support connectivity between several networks. The core requirements for this diversity are extensibility, modularity, scalability, and interoperability (Gubbi, et.al., 2013).

- **Security:** It is very important to secure data while it is being transferred between devices. Currently there are a security and privacy issues with IoT network. Evolving and developing this field will aid to make such issues vanish (Patel & Patel 2016).

2.2 Previous Studies

For the sake of the completion of this research, the researcher resorted to several studies in the field of IoT. Briefly, I will tackle each study in a more like summary approach and highlight main points in them:

- **Atzori, et,al.,(2010) The internet of things: A survey. Computer Networks.**

The IoT is a pattern where every time objects can be equipped with identifying, sensing, networking and processing capabilities that will allow them to communicate with each other and with other devices and services over the Internet to achieve some objective.

This study reported on the current state of IoT research by examining the literature, identifying current trends, describing challenges that threaten IoT diffusion, presenting open research questions and future directions, and compiling a comprehensive reference list to assist researchers

The IoT holds the promise of improving people's lives through both automation and augmentation. The capabilities offered by the IoT can save people and organizations time and money as well as help improve decision making and outcomes in a wide range of application

areas. The IoT builds on existing technologies such as RFID and Wireless Sensor Networks along with standards and protocols to support machine-to-machine communication such as those envisioned for the semantic web. One question that remains is whether or not the IoT is to be an enduring technology, whether it will fail to materialize, or whether it is a stepping stone to another paradigm.

- **Duan, et.al., (2011) A QoS architecture for IoT**

The application-oriented IoT is a combination of several types of technologies, rapidly developing in the world. Service quality is a combined indicator, being used to evaluate client satisfaction of a specific service. Generally, service quality means service quality of network; it is of service of network performance. Internet service quality focuses a lot on the performance requirement of end to end data transmission capacity. IoT is a complicated system; it has many tasks such as processing, transmission, perception, deciding and service providing. In addition it integrates technologies changes from perception device, communication network, to intelligent data processing etc. IoT is not merely a simple tech-integration system. Its service quality will appear in different layers and facets; the service quality consists of level of service space position and data accuracy, regardless from time delay, packet loss rate, transmission capacity in transmission network. Service quality is considered as an important factor in IoT applying. After analyzed the service quality requirements in every layer of IoT, we proposed service quality architecture for IoT which focuses on control mechanism for transferring and translation of service quality requirements from up to down.

- **Ickin, et.al., (2012) Factors Influencing Quality of Experience of Commonly Used Mobile Applications**

The extensive use of mobile applications in all activities of live, minor or major, ensued to support the need to obtain information, maintain communication or peruse leisure . With that being said, the end user resort to these applications depends on, to a certain point, two factors: the application perceive experience and how appropriate the application is for the user in terms of meeting his needs. The study presented a 4 week study on a 29 android phone users to define the abstract meaning of the quality of experience and the measures of quality of service.

With this respect, evaluation of quality of experience has mainly focused on an application's usability, which is evaluated in studies conducted for a limited time in controlled laboratory environments, under conditions that do not resemble users' natural daily environments. Hence, the outcomes of the evaluation aid to apprehend and discover the ongoing immediate usability issues.

- **Gubbi, et.al., (2013) Internet of Things (IoT): A vision, architectural elements, and future directions. Future Generation Computer Systems.**

The increasing of devices with communicating–actuating capabilities is bringing closer the vision of an IoT, where the sensing and actuation functions seamlessly blend into the background and new capabilities are made possible through access of rich new information sources. The evolution of the next generation mobile system will depend on the creativity of the users in designing new applications. IoT is an ideal emerging technology to influence this domain by

providing new evolving data and the required computational resources for creating revolutionary apps.

There are several application domains which will be impacted by the emerging IoT. The applications can be classified based on the type of network availability, coverage, scale, heterogeneity, repeatability, user involvement and impact. The author categorizes the applications into four application domains: Personal and Home; Enterprise; Utilities and Mobile. which represents Personal and Home IoT at the scale of an individual or home, Enterprise IoT at the scale of a community, Utility IoT at a national or regional scale and Mobile IoT which is usually spread across other domains mainly due to the nature of connectivity and scale in applications and the use of data between domains. For instance, the Personal and Home IoT produces electricity usage data in the house and makes it available to the electricity (utility) company which can in turn optimize the supply and demand in the Utility IoT. The internet enables sharing of data between different service providers in a seamless manner creating multiple business opportunities.

- **Jara, et.al., (2013). The Internet of Everything through IPv6: An Analysis of Challenges, Solutions and Opportunities.**

The IoT, or Machine-to-Machine (M2M), is one of the main drivers for the evolution of the internet towards the future internet. Nowadays, sensors, actuators and devices (so-called things), are connected to the Internet through gateways and platforms such as Supervisory Control and Data Acquisition platforms (SCADAs), panels, and brokers. These gateways and platforms break the end-to-end connection with the internet. For that reason, this initial approach is defined as an

IoT. The intranet is being extended to smart things with a higher scalability, pervasiveness, and integration into the Internet Core. This extension is leading to reach a real IoT, where things are first class citizens in the Internet, and they do not need to relay any more on a gateway, middleware, proxy, or broker.

The number of devices that are connected to the Internet is growing exponentially. This has led to defining a new conception of Internet, the commonly called Future Internet, which started with a new version of the Internet Protocol (IPv6) that extends the addressing space in order to support all the emerging Internet-enabled devices.

The communication architecture for the IoT is composed of the key components to enable security, mobility, and end-to-end connectivity/reliability. For the integration of everything, it needs to be considered all the rage of IoT technologies, such as 6LoWPAN (IEEE 802.15.4), Bluetooth Low Energy (IEEE 802.15.1) and Near Field Communication (NFC).

- **Farooq, et. al., (2015). A critical analysis on the security concerns of internet of things.**

IoT has been a main research topic for almost a decade these days, where physical things would be interconnected as a result of convergence of various existing technologies

The researcher analyzes the security issues and challenges and provides well-defined security architecture as a confidentiality of the user's privacy and security which could result in its wider adoption by masses.

Many researches being carried out, the vision of IoT will be realty soon. There are around 25 billion uniquely identifiable objects are expected to be a part of this global computing network by the year 2020, which is impressively a huge number, however prevalence of such a big network of interconnected devices will pose some new security and privacy threats and put all those devices at a high risk of hackers as they clutch at the security gaps to make the devices work for their personal benefits. The study focus on security issue that implements a security infrastructure of IoT, The major security goals of IoT are to ensure proper identity authentication mechanisms and provide confidentiality about the data.

- **Li, et.al., (2015) The internet of things: A survey. Information Systems Frontiers**

This study aimed at probing the role of IoT in the health care sector in its all parts. Healthcare is an important application area of IoT. This is adopted to enhance service quality and reduce costs. The study followed the analytical and descriptive methodology to dissect the samples to come up with the results sought for.

A number of medical sensors or devices are used to monitor medical parameters like blood pressure, blood glucose level, body temperature and. Another advanced sensor in health care was the newly emerged wearable body sensor networks (WBSNs) which was developed to monitor patient activities or medical parameters continuously. Noticeably, the concept of IoT in health care, through the sensors in the applications, basically relies on gathering information and transmits them to remote medical centers. In a broader look , the study incite a larger inclination in the health care sector , in its all fields , towards adopting the IoT which will ultimately reflects positively on the services presented and the general progress as well.

- **Islam, et.al., (2015) The Internet of Things for Health Care: A Comprehensive Survey**

The IoT makes the objects technologically smart to help aid in forming foundation for the development of cyber-physical pervasive frameworks. Among which, the health care domain which uses a wide variety of applications that share in revolutionizing whole domain and redesigning its aspects, either social or economic .

Healthcare sector is a highly sensitive domain and requires quality of service guarantees and success factors. Specifically, in other words , reliability , maintainability and a high standard of services are key factors that revolves around this sector or more like go along with it especially when we tends to employ technology in it .

The researcher undertook both analytical and descriptive approach to detect the importance of quality of service and the role of IoT in the health care sector. One of the most important results the study heighted is that the health care resorted to the IoT to elevate its physical aspects and enhance the it's values as being in direct contact with human health.

- **Li, et.al., (2015). The internet of things: a survey. Information Systems Frontiers.**

The IoT has drawn significant study attention. That is considered as a part of the Internet of the future and will comprise billions of intelligent communicating objects. The future of the Internet will consist of heterogeneously connected devices that will further extend the borders of the world with physical entities and virtual components.

The researcher has indicated that IoT is an objects connected together, where things are wirelessly connected via smart sensors, IoT is able to interact without human intervention. Some preliminary IoT applications have been already developed in healthcare, transportation, and automotive industries. Currently, IoT technologies are at their basic stages; however, many new developments have occurred in the integration of objects with sensors in the cloud-based Internet. The development of IoT involves many issues such as infrastructure, communications, interfaces, protocols, and standards.

IoT enables information gathering, storing and transmitting be available for things equipped with the tags or sensors. The tags have been widely used in supply chain management, manufacturing, environmental monitoring, retailing, smart shelf operations, healthcare, food and restaurant industry, logistic industry, travel and tourism industry, library services, and many other areas.

- **Bhaddurgatte & kumar (2015) QoS Architecture and Implementations in IoT Environment**

In terms of technology, (IoT) has become a subject of studies and research in almost all fields such as architecture, implementation, protocols, standardizations and quality of service management and implementations. Unprecedentedly, ‘things’ are becoming a significant part of our lives and objects stands alone and were shaped in a form of heterogeneous applications to sense the users’ needs and adapt with them. In this manner, these objects, as being an application, address the quality of service in (IoT) and shows its significance.

The researcher specified the results of the service quality architectures and schemes derived and defined by several research communities and academic organizations and based them on the

accurate study and understanding of service components, enabling technologies, message/data classification, application domain areas, and interactions between each of these modules/components. The impact of some service quality parameters may be affected by actions in other layers and the service quality schemes may not be independent on its own for any specific layer. For this reason the communication, data exchanges between layers are some of the critical factors influence the development of a cross layer service quality scheme.

The methodology adopted in this study was analytical and systematic as well. He systematically analyzed the IoT parameters and layers to define the objectives he sought to reach.

- **Corcoran & Datta (2016). Mobile-Edge Computing and the Internet of Things for Consumers**

The activities in the internet of things are now impeded in almost all fields. However, the main concentration is directed towards certain domains such as architectures, protocols and networking for the efficient interconnection of heterogeneous things, infrastructure deployment, and creation of value-added services. For the sake of the enhanced heterogeneity, the vast majority of the IoT are supported by cloud - computing features which will ultimately drive to the needed quality of service.

In this short study, the researcher sets the focus on cloud computing and its repercussions on the IoT and its benefits to it as well. For this very issue 15 articles were received. And after being reviewed, some of them published as being deemed of high quality.

- **Zhu Jing (2016). Airline service quality performance: comparison of air China and Hanan Airline.**

Mainly, aviation business concerns with a direct contact between customers and representatives of the services in the airline company. This, by default, means an Airline should have the ability to present its customers with the services in a frame of high quality in terms of costs, secondary services, primary services, and goes up until it reaches "the welfare of a customer ".

In his study, the researcher used a comparative methodology to analyze the service quality performance in both Air China and Hainan Airline

By nature, Airline companies' main stream is competitiveness in the sense that they strive their best to provide services with high quality that give them excellence in the market and give them added values to meet customers' expectations.

The tendency towards the IoT gave the Airline companies many factors of success. They became aware that any application they use to make the life of a customer easy is one of the elements of marching the road of progress.

As per the researcher, the study has some limitations. The main affecting was the size of the sample was small and limited to time and manpower. For any future study, he recommended analyzing a larger sample to broadly cover more passengers.

- **Gong, W. (2016) The Internet of things (IoT) what is the potential of the internet of things (IoT) as a marketing tool**

The internet is a key part of the future internet. Many new opportunities can be foreseen for business and marketers as well. This study acknowledges the marketing aspects of the internet of things application as it will have a huge impact on the near future. The evidences show that IoT will revolutionize the market landscape. Cognitive IoT technologies will make it possible for business leaders to understand the world. Integrating business with intelligence – technology – Internet of things – things and process will be perfected efficiently and processes will be more sensible and clear as will. As such, dealing with risk and threats will be more likely anticipatable and ultimately dealt with.

The research aims to analyze the potential of the IoT as a marketing tool within the businesses activities. Through the analysis, the study will set a classification for the market domains where the IoT plays a role the future and the identification the main changes expected to happen in the market works. The outcomes of the study stated that the IoT and the market space are closely connected. The Internet of things can classify markets and the advantages that it can gain from being technologically savvy. To come up with that result, the author undertook an analytical approach.

- **Patel & Patel (2016). Internet of things-IOT: definition, characteristics, architecture, enabling technologies, application & future challenges.**

The IoT concept was coined by a member of the Radio Frequency Identification (RFID) development community in latest 90s, and it has recently become more relevant to the practical

world largely because of the growth of mobile devices, embedded and ubiquitous communication, cloud computing and data analytics.

The researchers define IoT into three categories: IoT is an internet of three things: people to people, people to machine /things, and things /machine to things /machine. This interacts through internet.

The vision of IoT: is a concept and a paradigm that considers pervasive presence in the environment of a variety of things/objects that through wireless and wired connections and unique addressing schemes are able to interact with each other and cooperate with other things/objects to create new applications/services and reach common goals.

The characteristics of IoT are: interconnectivity things-related services, heterogeneity, dynamic changes, enormous scale, safety, connectivity and connectivity.

- **Park, et.al., (2016)User Experience and Quality-of-Service in Internet of Things**

The accelerated growth in the IoT left a huge influence on all features of our lives. The increased dependence on the IoT proves that it is phenomena made our live better and easy which is resembled in the quality of services. As such, the attitude or more like the look to the quality of service has become a subject of scrutiny and a required aspect in all domains. IoT made the quality of service a human-centric and companies and businesses, accordingly, make quality assurance a significant part of their entities.

The author's approach was systematic, descriptive and comparative at the same time. He relied on taking reviews of sample customers to define the aspects of their experience with the IoT.

The study is expected to be triggered in mobile and wireless communications research area for future IoT and UX works.

- **Kim (2016) A quality model for evaluating IoT applications**

As the need for the IoT application is growing and taking a positive turn towards bettering the quality of services, Mi Kim, in this study, lays extra focus or more like presents suggestions to for quality models to evaluate IoT applications.

IoT is the computing environment to provide valuable services by interacting with various IoT applications, where diverse devices are connected within the existing internet infrastructure and through intelligent social applications. As such, within this context, it is rather crucial that these applications should be subject to evaluation through customized models. This will give the ability to identify the acceptance criteria and evaluate the particular application domain.

"For instance, ISO 9126 which is a representative quality model is mainly for conventional software, not addressing the IoT characteristics. That is the quality attributes and metrics in ISO 9126 would largely inappropriate in measuring the quality of IoT applications"

- **Khodkari, et.al., (2016) Necessity of the integration Internet of Things and cloud services with quality of service assurance approach**

IoT is mostly described by actual world tiny things, vastly distributed, with limited storage and processing capacity, which include concerns regarding security, reliability, privacy and performance. Moreover, Cloud computing has practically infinite capabilities in terms of storage

and processing power, is a much more overripe technology, and has most of the IoT issues at least partially solved.

The right worth of the IoT for enterprises can be recognize when connected devices are able to connected with each other and integrate with customer support systems, vendor-managed inventory systems, business intelligence applications, and business analytics. Heterogeneous networks considered multi-service by default; providing more than one distinct application or service. This sight not only multiple traffic kinds within the network, but also the ability of a single network to support all applications without service quality compromise. There are two application categories: throughput and delay tolerant elastic traffic of (ex. monitoring weather parameters at low sampling rates), and the bandwidth and delay sensitive inelastic -real-time- traffic (ex. noise or traffic monitoring), which can be further distinguished by data-related applications (ex. high & low resolution videos) with different service quality requirements. Integration of cloud computing and the IoT represents the next great leap forward in the future internet. Application of this integration, which is called cloud IoT, valuable new tracks, will open for business and research. This integration can draw close to future smart cities.

- **Li, B & Li, Y (2017) Internet of things drives supply chain innovation: A research framework**

The IoT connect products machines and people together. This concept has been realized recently through new technologies in sensor devices, data storage and decision taking tools. This wide spread paved the way for a high potential use of it in the Supply Chain Management (SCM), specifically the Supply Chain Innovation (SCI).

The IoT is expected to expand about 26 billion network-connected devices by 2020, enabling the control of mostly every machine and human activity, from how many steps we walk daily to the way machines run every second. Cisco predicts the IoT boosts global corporate profits by 21% and its market is to be $19 trillion dollars.

By connecting machines, people, products, and supply chain members, a new environment for supply chain managers provided by IoT. It enables information communication and process integration, allows machine enabled decision-making, and enhances more efficient and effective supply chain management. In this entirely new business and technology environment, supply chain managers need to create their traditional SCM practices and strategies.

- **White, et.al., (2017) Quality of service approaches in IoT: A systematic mapping.**

The heterogeneous devices are, in a way, tightly connected to the IoT as being an environment that is fittingly perfect for users to get advantage of with style and quality in terms of the services they provide. This would be impeded in the different layers of IoT architecture, keeping in mind the various quality of service factors involved.

This research stands to assesses the proposed quality of service approaches and factors in the IoT formation , in specific : 1- The layers of the IoT architecture that are most studied in terms of quality of service (2) What quality factors do the quality approaches take into account when measuring performance? (3) What types of research have been conducted in this area? .For this purpose, a systematic mapping using a number of automated searches from the most relevant academic databases to address these questions has been conducted.

- **Simiscuka, et.al., (2017) Performance Analysis of the Quality of Service aware Networking Scheme for Smart Internet of Things Gateways**

The objective of the research was to investigate 25 billion devices expected to be part of IoT networks by 2020. Designing solutions to network needs very much effort, many devices while maintaining good quality for the diverse supported services. Adaptive solutions considering different sides for content delivery adjustment were proposed for video distribution over classic and heterogeneous network environments. Service quality levels and energy consumption are usually the metrics measured to verify the quality and efficiency of these services, which is important as IoT is often supported by a heterogeneous network environment. The heterogeneity in IoT networking brings challenges regarding efficient data transmission, and the performance analysis of the different variables related to data transmission is thus of high importance.

- **Dey & Mukherjee (2018). Towards Automation of IoT Analytics: An Ontology-Driven Approach.**

The world is moving towards a direction of "Internet of Everything", a step forward from the era of "Internet of Things", as number of connected and deployed objects around us are increasing at a very high rate. They are predicted to reach 25 billion by 2020. Each of these objects is uniquely addressable and communicates with each other and outer world based on standard communication protocols.

This growth in number of smart objects translates into generation of a tremendous volume of data which in turn translates into a huge requirement of data storage, and an efficient and fast communication network. Moreover, all connected objects do not send data in similar format;

they are controlled by different stake holders and cater to different use cases involving variety of knowledge domains. There is heterogeneity in terms of hardware and software versions which are again controlled by multiple independent communities. To sum up, the heterogeneity present in the IoT world due to obvious reasons is a major challenge facing researchers in this domain.

In order to develop such intelligent and useful IoT applications, one should (1) identify the most appropriate data sources together with the detailed specification of the sources, ex: the sensors, (2) properly collect the data, (3) identify the data format thereof and (4) understand which part of the data is useful for the application.

- **Tanganelli, et.al., (2018) Ensuring Quality of Service in the Internet of Things**

The IoT crystalized and polished the processes and procedures, in a wide range, in all fields and businesses and altered them from personal to industrial .This entailed institutions, companies, organizations and etc. to guarantee required levels of reliability and readiness in order to provide high quality services to customers. Hence, the IoT systems need ostensible support at all various levels. At the network level, specific technical communication standards will be necessary to ensure timed and reliable data delivery. IoT systems are expected to be employed in a large number of use cases for heterogeneous applications. For some of them, such as smart industrial or smart grid systems, explicit support for quality of service is mandatory.

The methodology adopted in this study was analytical. The author surveyed the current approaches that deals with the mechanism of using the IoT to up the quality of services

The researcher concluded that despite the fact that quality of service support for IoT is being made available for all platforms, either as a protocol specification or real implementations; it is, yet, not exploited and employed properly by these platforms.

2.2.1 Distinctive Features of the Current Study.

So many scholars have studied IoT, and quality of service, but they have paid little attention to the factors (Intelligence, Connectivity, Dynamic Nature, Enormity, Sensing, Diversity and Security) and its impact on quality of service.

Therefore, this study might be the first of its kind that sheds light on the impact of internet of things on quality of service in aviation.

After reviewing many IoT literatures, it has come clear that the studies that deal with the IoT in the aviation field are quite few whereas in other fields like the health cares were quite abundant. This study laid down some comparisons between the IoT in the aviation sector and some other sectors, such as health care and industrial sectors, all was done in light of the few existed studies that the researcher could depend on.

As a comparison, this research paper touched upon the effect of the IoT on the quality of service. In this context, the study focused on seven dimensions that are related to the IoT and how these dimensions have positive impact on the quality of service in the aviation field. The researcher followed both descriptive and analytical approach to dissect all these dimensions and point out the importance of each one for the IoT and ultimately their reflections on the users as being the

service receptors. Some other studies that dealt with the IoT in other sectors, in a way or another, fell short in studying the IoT in its all dimensions.

The (Islam, et.al., 2015) study about health care which I sought to adduce in this research paper touched upon the IoT and dealt with it as a concept reflecting a connected set of anyone, anything, anytime, anyplace, any service, and any network. According to the researcher, the IoT plays a crucial role in upping the quality of service in the health sector.

The common ground between almost all studies including this study was that the quality of services is highly improved by the extensive use of IoT. As an example, but not limited, a study presented in this research, ensuring quality of service in the IoT by tangible clearly stated that the services presented to users through the IoT applications are polished and refined and get the users satisfied . To reach this, the study suggested that the operator or owner of the IoT or the applications guarantee the required level of reliability and reediness at all times and places.

Chapter Three

Study Methodology (Method and Procedures)

3.1 Study Methodology

3.2. Study Population

3.3 Study Sample

3.4 Study Data Collection Tools

3.5 Tests for the study instrument

3.6 Study Variables

3.7 Normality

Chapter Three

Study Methodology (Method and Procedures)

The researcher clarifies in this chapter the system of the investigation and its techniques. It also describes the methodology used by providing the population and sample, data collection tools, reliability and validity.

3.1 Study Methodology

The researcher used descriptive analytical method to classify and analyze the data to describe the population of the study by recording the researcher of the events and presenting them and describing them through analytical descriptive. Data were collected by the questionnaire and analyzed using the SPSS program. Which relate to the variables of the study, to reach real results and propose appropriate recommendations?

In this thesis an Internet of Things testing on Quality of Service to evaluating and acceptance by Royal Jordanian passengers during a survey methodology which employed to collect data, which aims to test the impact of using Internet of things on quality of service.

This study follows the descriptive and analytical approach. Descriptive approach depends on literature review to build the conceptual frame work and exploring the relationships between the study variables. Literature review extended also to develop the questioner items. Analytical approach used to assure reliability and validation for the measurement scale and testing the hypotheses and interpreting the results regarding the data gathered.

3.2 Study Population

The field of the current study was in Queen Alia International Airport in Amman which is the main and largest airport in Jordan. As the population of the study is customers' passengers who use the Royal Jordanian application and self-check in were deemed as the targeted samples of the study.

3.3 Study Sample

As mentioned above that the population of the study was the Royal Jordanian airline passengers. The study is based on a purposive sample for Royal Jordanian airline passengers. According to Sakaran & Bougie (2013) and as the population is unknown, the sample study size was estimated to be 385.

The Questionnaire:

Initial items to measure various variable of the study were developed depending on prior researchers.

All variables were measured by five-point Liker-type scale to tap into thepassengers, ranging from value 1 (strongly disagree) to value 5 (strongly Agree) used through the questionnaire. Same questionnaire was in both languages, Arabic and English for Arabs and foreign passengers.

3.4 Study data Collection Tools

This study depends on two sources to collect data:

Primary Source: The researcher developed a measurement scale based on previous studied to measure the (intelligence, connectivity, dynamic nature, enormity, sensing, diversity, and security with quality of service).

Secondary Source: The secondary sources were based on **Books**, Journals, Theses, Articles, and Worldwide Web to write theoretical framework of this study.

3.5 Tests for the study instrument

Instrument validity:

The questionnaire was presented to a group of arbitrators from the Middle East University and several other universities; Based on their observations, the questionnaire was modified

Instrument Reliability:

To measure the reliability of the questionnaire and the level of internal consistency of its items, the coefficient of Cronbach Alpha was calculated.

Cronbach's alpha test was used to assess the reliability of the research instrument.

Table (3-1) below shows results for the 40 statements of the questionnaire and how closely related a set of items are as a group over the sample of 378 respondents.

Table (3-1) Reliability Analysis Through Cronbach Alpha Results

Independent Variables	No. of Items	Cronbach's Alpha
Connectivity	**5**	**0.903**
Security	**5**	**0.923**
Diversity	**5**	**0.920**
Intelligence	**5**	**0.933**
Sensing	**5**	**0.950**
Dynamic Nature	**5**	**0.945**

Enormity	**5**	**0.930**
Dependent Variables		
Quality of Service	**5**	**0.931**
All Variables	**40**	**0.987**

The table above shows that the independent variables Cronbach's alpha values equal to (0.903, 0.923, 0.920, 0.933, 0.950, 0.945 and 0.930) respectively, and the dependent variable (Quality of Services) Cronbach's alpha value equals to (0.931). The overall value is (0.987) indicating high level of reliability of the questionnaire reflecting relatively high internal consistency, since the reliability coefficient of 0.70 or higher is considered "acceptable" in the majority social science research situations (Nunnally, 1978, P245).

3.6 Study Variables

- **Independent Variable:** (intelligence, connectivity, dynamic nature, enormity, sensing, diversity, and security.
- **Dependent Variable:** quality of service.

3.7 Normality

To ensure normality of the distribution of skewness and kurtosis coefficients were assessed. Multivariate normality for data distribution can be achieved when kurtosis value not much larger than three or four. On the other hand, absolute value of skewness of all variables is less than three and the absolute value of the kurtosis is less than 10 (Bartolini, 2005)

Table (3-2) Normality test

Independent Variables	Skewness	Kurtosis
Connectivity	**-0.486**	**0.124**
Security	**-0.375**	**0.014**
Diversity	**-0.493**	**0.014**
Intelligence	**-0.504**	**-0.108**
Sensing	**-0.490**	**-0.363**
Dynamic Nature	**-0.366**	**-0.284**
Enormity	**-0.375**	**-0.495**
Dependent Variable		
Quality of service	**-0.375**	**-0.322**

Table (3-2) contains the table above contains the skewness and kurtosis values. The values are considered to be close to the normal distribution if it lies (-3 and +3). The obtained values proved that the data distribution is normally distributed (George & Mallery, 2010).

Chapter Four

Data Analysis and Hypotheses Testing

4.1 Sample Characteristics

4.2 Descriptive Analyses

4.3 Testing the Hypotheses

Chapter Four

Data Analysis and Hypotheses Testing

The sections below shows the statistical analyses and tests used to describe and analyze the collected data from 378 respondents who answered the questionnaire and 7 questionnaires were unable to analyze. SPSS version 21 was used to describe and analyze the data.

4.1 Sample Characteristics

The sample characteristics results in table (4-1) below, where the respondents nationalities were from 11 different countries (300 respondents from Jordan, Egypt 6 respondents, Iraq 12 respondents, Germany 12 respondents, KSA 6 respondents, Kuwait 6 respondents, Lebanon 6 respondents Syria 3 respondents, UK 12 respondents, 3 respondents from Bosnia and USA 12 respondents).

The number of male respondents is 243 and the number of female respondents is 135, also the ages of respondents were as follows (12 of them were between 18-30 years old, 159 between 31-45 years old, 159 of them between 46-60 years old and 48 of them were above 60 years old).

Most of the respondents have bachelor degree or less and their number was 324 respondents, and the other 54 respondents were post graduate.

Since Jordanians are the main customers of Royal Jordanian Airline, the majority of the targeted sample was Jordanian and the setting of the research was Queen Alia International Airport in Jordan. The majority of Royal Jordanian Airline customers are male and this justifies the larger number of male passengers in the targeted sample. Where the majority of passengers using RJ mobile applications are between 31- 60 because they are mostly business passengers and frequent flyer passengers.

141 respondents were using smart phones with IOS software, 228 respondents were using smart phones with Android software that's because most of Jordanian passengers use Samsung or Huawei smart phone, 6 were using smart phones with windows software and 3 of them were using smart phones with black berry software.

Table (4-1) the sample's demographic variables description

Variable	Category	Counts	Percent
Gender	Males	243	64.3
	Females	135	35.7
	Total	378	100
Age	18-30	12	3.2
	31-45	159	42.1
	46-60	159	42.1
	Above 60	48	12.7
	Total	378	100
Nationality	Jordan	300	79.4
	Egypt	6	1.6
	Iraq	12	3.2
	Germany	12	3.2
	KSA	6	1.6
	Syria	3	0.8
	Lebanon	6	1.6
	UK	12	3.2
	Kuwait	6	1.6

	Bosnia	**3**	**0.8**
	USA	**12**	**3.2**
	Total	**378**	**100**
Education	**Bachelor degree or less**	**324**	**85.7**
	Post graduate	**54**	**14.3**
	Total	**378**	**100**
Smart phone Software	**IOS**	**141**	**37.3**
	Android	**228**	**60.3**
	Windows	**6**	**1.6**
	Black berry	**3**	**0.8**
	Total	**378**	**100**

4.2 Descriptive Analyses

Below, the descriptive analysis of the research tool is presented.

The researcher relied on the following scale to describe the mean values based on the following:

Category length = (highest weight "5" – lowest weight "1") / No. of categories

Category length = 4/5 = 0.80

1 – 1.80 very low

1.81 – 2.60 low

2.61 – 3.40 moderate

3.41 – 4.20 high

4.21 – 5.00 very high

Descriptive Statistics for the Independent Variables

Analyzing the items of the independent variables (The impact of Using Internet of things on Quality of service in Royal Jordanian Airline from passengers point of view), Means and standard deviations, were calculated for each item.

The results are included in tables below.

Table (4-2) means and standard deviations for the items of (Connectivity)

No.	Items	Mean	Sd	level	Rank
1	The passenger can easily reach the applications (such as booking, frequent flyer, check-in, flight information) from anywhere.	**4.34**	**0.681**	**v. High**	**1**
3	Applications related to (reservation, frequent flyer, check-in, flight information) work on all Wi-Fi, 3G, and 4G networks.	**4.17**	**0.747**	**High**	**2**
2	Updating the applications (reservation, frequent flyer, check-in, and flight information) does not affect the previously inserted passengers' information.	**4.08**	**0.804**	**High**	**3**
5	Application used can connect to more than one system (such as booking, check-in, frequent flyer, flight information and boarding, etc.).	**3.97**	**0.891**	**High**	**4**
4	The application sends a notification (such as delay, updated flight information, etc.).	**3.95**	**0.873**	**High**	**5**
	Overall Mean	**4.10**	**0.681**	**High**	

Means description (1 – 1.8 v. low, 1.81 – 2.6 low, 2.61 – 3.40 moderate, 3.41 -4.20 high and 4.21 – 5 v high)

Table (4-2) indicates the values of means and standard deviation, for the Connectivity. Statement no. 1 " The passenger can easily reach the applications (such as booking, frequent flyer, check-in, flight information) from anywhere." was the most item being rated by the study sample as it ranked the first by a mean of (4.34) that's because the application enables passengers using it from anywhere in the world easily to take advantage of the service provided by Royal Jordanian

airline, where the connectivity is one of the most important factor in IoT, while statement no. 4 which states " The application sends a notification (such as delay, updated flight information, etc.) " was the lowest item being rated by the study sample as its mean was the least (3.95). The overall assessment degree of (Connectivity) was rated by a mean of (4.10). This value expresses a high level of agreement among the study sample.

Table (4-3) means and standard deviations for the items of (Security)

No.	Items	Mean	Sd	level	Rank
2	Applications protect the personal information of the passengers.of resources.	**4.10**	**0.816**	**High**	**1**
1	Applications (Check-in, Frequent Flyer, Trip Information, and Boarding) are being updated regularly.	**4.06**	**0.825**	**High**	**2**
5	The application (check-in, frequent flyer, flight information, boarding) authenticate itself in the network once the passenger logs in.	**4.01**	**0.822**	**High**	**3**
4	The application contains several fields to be filled to verify the identity of the passenger.	**3.96**	**0.869**	**High**	**4**
3	The application enables the entitled listed passengers only to use applications (check-in, frequent flyer, flight information, and boarding).	**3.90**	**0.860**	**High**	**5**
	Overall Mean	**4.00**	**0.733**	**High**	

Means description (1 – 1.8 v. low, 1.81 – 2.6 low, 2.61 – 3.40 moderate, 3.41 -4.20 high and 4.21 – 5 v high)

Table (4-3) indicates the values of means and standard deviation, for the Security. Statement no. 2 " Applications protect the personal information of the passengers." was the most item being rated by the study sample as it ranked the first by a mean of (4.10) that's because one of the most important things for passengers is to protect their personal information which is protected by the application and encourage passengers to use it, while statement no. 3 which states " The application enables the entitled listed passengers only to use applications (check-in, frequent

flyer, flight information, and boarding). " was the lowest item being rated by the study sample as its mean was the least (3.90). The overall assessment degree of (Security) was rated by a mean of (4). This value expresses a high level of agreement among the study sample.

Table (4-4) means and standard deviations for the items of (Diversity)

No.	Items	Mean	Sd	level	Rank
1	The application (check-in, frequent flyer, flight information, and boarding) can be used from mobile devices or tablet.	**4.13**	**0.840**	**High**	**1**
3	The internet applications are being used in many fields (Aviation, Smart Homes, Smart Cities, etc.)	**4.05**	**0.854**	**High**	**2**
2	The application can be installed on the Mobile or tablets and can be downloaded from different stores as well.	**4.03**	**0.797**	**High**	**3**
5	The application contains several functions (reservation, check-in, frequent flyer, flights information, etc.)	**3.98**	**0.798**	**High**	**4**
4	Passengers can use the application(check-in , frequent flyer and flight information) in the Self check-in devices in the Airport	**3.90**	**0.899**	**High**	**5**
	Overall Mean	**4.01**	**0.729**	**High**	

Means description (1 – 1.8 v. low, 1.81 – 2.6 low, 2.61 – 3.40 moderate, 3.41 -4.20 high and 4.21 – 5 v high)

Table (4-4) indicates the values of means and standard deviation, for the Diversity. Statement no. 1 " The application (check-in, frequent flyer, flight information, and boarding) can be used from mobile devices or tablet." was the most item being rated by the study sample as it ranked the first by a mean of (4.13) because of the diversity of technology, the passenger can use the application from mobile or tablet, not limited to a specific device, which gives the passenger more option for use, while statement no. 4 which states " Passengers can use the application(check-in , frequent flyer and flight information) in the Self check-in devices in the Airport " was the lowest item being rated by the study sample as its mean was the least (3.90). The overall assessment degree

of (Diversity) was rated by a mean of (4.01). This value expresses a high level of agreement among the study sample.

Table (4-5) means and standard deviations for the items of (Intelligence)

No.	Items	Mean	Sd	level	Rank
1	Passengers using the application (check-in, frequent flyer, flight information, and boarding) can automatically manage their reservations for upcoming flights (seat number, meals, etc.)	**4.05**	**0.917**	**High**	**1**
4	The application sends notification of preferred offers, flights, dates and discounts based on previous flights.	**3.89**	**0.894**	**High**	**2**
2	Passengers using application for boarding can use the barcode for the boarding system.	**3.85**	**0.945**	**High**	**3**
3	The application automatically registers passengers in the frequent flyer program to add points.	**3.77**	**0.970**	**High**	**4**
5	The application makes record of the passengers' information and pattern of travel.	**3.75**	**0.889**	**High**	**5**
	Overall Mean	**3.86**	**0.820**	**High**	

Means description (1 – 1.8 v. low, 1.81 – 2.6 low, 2.61 – 3.40 moderate, 3.41 -4.20 high and 4.21 – 5 v high)

Table (4-5) indicates the values of means and standard deviation, for the Intelligence. Statement no. 1 " Passengers using the application (check-in, frequent flyer, flight information, and boarding) can automatically manage their reservations for upcoming flights (seat number, meals, etc.)." was the most item being rated by the study sample as it ranked the first by a mean of (4.05) the application is considered a smart application that automatically manages their upcoming travel reservations according to their desire, such as seat number, meals, etc. While statement no. 5 which states "The application makes record of the passengers' information and pattern of travel." was the lowest item being rated by the study sample as its mean was the least (3.75). The overall assessment degree of (Intelligence) was rated by a mean of (3.86). This value expresses a high level of agreement among the study sample.

Table (4-6) means and standard deviations for the items of (Sensing)

No.	Items	Mean	Sd	level	Rank
1	The application enables passengers to locate their gates, favorite restaurants at the airport etc.	**3.90**	**0.939**	**High**	**1**
4	The application can guide passengers to the boarding gates, restaurants, and the service area like Google Map.	**3.71**	**1.091**	**High**	**2**
3	The application enables passengers to check-in through their fingerprint as per their booking.	**3.70**	**1.019**	**High**	**3**
2	Upon arrival, the application sends a notification to the passenger with the number of the baggage delivery belt.	**3.69**	**1.096**	**High**	**4**
5	The application contains links to other applications related to passengers (e.g., mobility applications, car rentals).	**3.67**	**1.054**	**High**	**5**
	Overall Mean	**3.73**	**0.951**	**High**	

Means description (1 – 1.8 v. low, 1.81 – 2.6 low, 2.61 – 3.40 moderate, 3.41 -4.20 high and 4.21 – 5 v high)

Table (4-6) indicates the values of means and standard deviation, for the Sensing. Statement no. 1 " The application enables passengers to locate their gates, favorite restaurants at the airport etc." was the most item being rated by the study sample as it ranked the first by a mean of (3.90) that's because the application helps the passengers to find locations such as boarding gates, restaurants, etc. at the airport and do not wasting their time for looking for that. The application helps to reach the required places. while statement no. 5 which states " The application contains links to other applications related to passengers (e.g., mobility applications, car rentals)." was the lowest item being rated by the study sample as its mean was the least (3.67). The overall assessment degree of (Sensing) was rated by a mean of (3.73). This value expresses a high level of agreement among the study sample.

Table (4-7) means and standard deviations for the items of (Dynamic Nature)

No.	Items	Mean	Sd	level	Rank
1	The Application (booking, check-in, frequent flyer, flight information, and boarding) makes the travel journey easier.	**3.98**	**0.837**	**High**	**1**
3	The application (booking, check-in, frequent flyer, flight information, and boarding) is accessible at all times.	**3.92**	**0.915**	**High**	**2**
4	The application accepts all types of credit cards.	**3.82**	**0.939**	**High**	**3**
2	The application responds directly to users with travel requests.	**3.79**	**0.868**	**High**	**4**
5	Discounts can be obtained when using the application.	**3.79**	**0.921**	**High**	**5**
	Overall Mean	**3.86**	**0.811**	**High**	

Means description (1 – 1.8 v. low, 1.81 – 2.6 low, 2.61 – 3.40 moderate, 3.41 -4.20 high and 4.21 – 5 v high)

Table (4-7) indicates the values of means and standard deviation, for the Dynamic Nature. Statement no. 1 " The Application (booking, check-in, frequent flyer, flight information, and boarding) makes the travel journey easier." was the most item being rated by the study sample as it ranked the first by a mean of (4.04) through the dynamic nature of the application that's helps passengers to what they need during their travel, makes their journey easy from beginning to end. while statements no. 2 and 5 were the lowest items being rated by the study sample as their means values was the least (3.79). The overall assessment degree of (Dynamic Nature) was rated by a mean of (3.86). This value expresses a high level of agreement among the study sample.

Table (4-8) means and standard deviations for the items of (Enormity)

No.	Items	Mean	Sd	level	Rank
2	The extensive use of the application (booking, check-in, frequent flyer, flight information, and boarding) improves the quality of service.	**4.09**	**0.798**	**High**	**1**
3	The extensive use of the application (booking, check-in, frequent flyer, flight information, and boarding) saves effort.	**4.02**	**0.883**	**High**	**2**
4	The Use of application (booking, check-in, frequent flyer, flight information, and boarding) is part of the Smart City.	**3.95**	**0.854**	**High**	**3**
5	The application (booking, check-in, frequent flyer, flight information, and boarding) provides passengers with the needed information (number of flights, travel points earned etc.)	**3.94**	**0.955**	**High**	**4**
1	Mobile applications can be used in many different areas (such as aviation, healthcare, smart home, etc.)	**3.86**	**0.916**	**High**	**5**
	Overall Mean	**3.97**	**0.780**	**High**	

Means description (1 – 1.8 v. low, 1.81 – 2.6 low, 2.61 – 3.40 moderate, 3.41 -4.20 high and 4.21 – 5 v high)

Table (4-8) indicates the values of means and standard deviation, for the Enormity. Statement no. 2 " The extensive use of the application (booking, check-in, frequent flyer, flight information, and boarding) saves effort." was the most item being rated by the study sample as it ranked the first by a mean of (4.09) through the extensive use of the application by passengers, the quality of service provided by Royal Jordanian improves. Where the company continuously develops the application with passengers requirements. While statement no. 1 which states "Mobile applications can be used in many different areas (such as aviation, healthcare, smart home, etc.)" was the lowest item being rated by the study sample as its mean was the least (3.86).The overall assessment degree of (Enormity) was rated by a mean of (3.97). This value expresses a high level of agreement among the study sample.

Analyzing the items of Dependent Variable (Quality of Service)

Table (4-9) means and standard deviations for the items of (Quality of Service)

No.	Items	Mean	Sd	level	Rank
1	The application (check-in, frequent flyer, flight information, and boarding) achieves efficient use of resources.	**4.02**	**0.817**	**High**	**2**
2	Passengers can replace traditional ways and adapt to the application usage (check-in, frequent flyer, flight information, and boarding).	**3.95**	**0.816**	**High**	**3**
3	The passenger can rely on the application to manage his/her reservations and travel procedures any time.	**3.89**	**0.848**	**High**	**5**
4	The application can be used by all genres (age, gender, culture of background).	**3.90**	**0.905**	**High**	**4**
5	The application (check-in, frequent flyer, flight information, and boarding) is protected software.	**4.04**	**0.812**	**High**	**1**
	Overall Mean	**3.9603**	**0.74422**	**High**	

Means description (1 – 1.8 v. low, 1.81 – 2.6 low, 2.61 – 3.40 moderate, 3.41 -4.20 high and 4.21 – 5 v high)

Table (4-9) indicates the values of means and standard deviation, for the Quality of Service. Statement no. 5 " The application (check-in, frequent flyer, flight information, and boarding) is protected software." factor recorded the highest mean among the factors being rated (by the study sample) as it ranked the first by a mean of (4.04) because the application is considered a protected software, this increase the quality of service provided by Royal Jordanian, by protecting the information and privacy of passengers. while statement no. 3 which states " The passenger can rely on the application to manage his/her reservations and travel procedures any time" was the lowest item being rated by the study sample as its mean was the least (3.89).The overall assessment degree of (Quality of Service) was rated by a mean of (3.9603). This value expresses a high level of agreement among the study sample.

4.3 Testing the Hypotheses

The research questionnaire was distributed to a sample of 385 passengers in Queen Alia International Airport in Amman. As the population of the study is customers' passengers who use the Royal Jordanian application and self-check in, to make sure that the statements are understandable and obvious, both languages Arabic and English are simple and clear, the nature of the passengers' response to the statements fit the intended meaning, and the questionnaire measures what it's supposed to measure. Necessary tests were also carried out and necessary modifications have been taken based on the results as demonstrated in the following sections.

Testing the First Main Hypothesis

$H_0$1: There is no significant impact of using IoT (Intelligence, Connectivity, Dynamic Nature, Enormity, Sensing, Diversity and Security) on quality of service in Royal Jordanian Airline from passenger's point of view, at the level of significance ($\alpha \leq 0.05$).

H_a1: There is a significant impact of using IoT (Intelligence, Connectivity, Dynamic Nature, Enormity, Sensing, Diversity and Security) on quality of service in Royal Jordanian Airline from passenger's point of view, at the level of significance ($\alpha \leq 0.05$).

Table (4-10) Multiple Linear Regression for testing the impact of using IoT (Intelligence, Connectivity, Dynamic Nature, Enormity, Sensing, Diversity and Security) on quality of services

Independent Variable	**Person Correlation (R)**	**(β)**	**Sig(t)**	***p*-value Sig. F**	**Hypothesis Support**
Connectivity	**0.799 Sig. = 0.000**	**0.016**	**0.736**	**0.000**	**Reject H_{01}**
Security	**0.868 Sig. = 0.000**	**0.209**	**0.000**		
Diversity	**0.868 Sig. = 0.000**	**0.323**	**0.000**		
Intelligence	**0.811 Sig. = 0.000**	**0.131**	**0.001**		
Sensing	**0.745 Sig. = 0.000**	**- 0.189**	**0.000**		
Dynamic Nature	**0.824 Sig. = 0.000**	**0.118**	**0.009**		
Enormity	**0.876 Sig. = 0.000**	**0.371**	**0.000**		
Adjusted R^2=0.847					

Table (4-10) shows the results of the impact of using IoT (Intelligence, Connectivity, Dynamic Nature, Enormity, Sensing, Diversity and Security) on quality of services in Royal Jordanian Airline from passenger's point of view.

The **IoT** independent variables (Intelligence, Connectivity, Dynamic Nature, Enormity, Diversity and Security) has a strong significant positive, and the Sensing has significant negative relationship with the dependent variable (quality of service) were the values of person correlation were greater than 0.70 (David 2012) as shown in the table above also all values of the significant level were less than 0.05.

Also the value of **Adjusted R Square** is equal to 0.847, and that means the independent variables can explain 84.7% of the variation in dependent variable (**Quality of Service**) which is a very big percentage.

There is significant impact of the independent variables of using **IoT** on **Quality of service** in Royal Jordanian Airline from passenger's point of view, were the *p*-value was equal to (0.000 less than 0.05) so we reject the null hypothesis.

The biggest impact was from the variable Enormity were Beta value was equal to 0.371, then come the variables (Diversity, Security, Sensing, Intelligence, Dynamic Nature) respectively with beta values equal to (0.323, 0.209, 0.189, 0.131 and 0.118), and the least impact was from connectivity with beta value equals to 0.016 and it was found insignificant impact for connectivity since sig (t) = 0.736 which is greater 5%

Testing the First Sub Hypothesis

$H_{01.1}$: There is no impact of using IoT Intelligence on quality of service in Royal Jordanian Airline from passenger's point of view at the level of significance ($\alpha \leq 0.05$).

$H_{a1.1}$: There is an impact of using IoT Intelligence on quality of service in Royal Jordanian Airline from passenger's point of view at the level of significance ($\alpha \leq 0.05$).

Table (4-11) simple linear regression for testing the impact of using IoT Intelligence on the Quality of Service Availability in Royal Jordanian Airline from passenger's point of view

Independent Variable	(β) Value	t value	Sig. t	F value	*p*-value Sig. F	Hypothesis Support
Intelligence	**0.736**	**26.915**	**0.000**	**724.406**	**0.000**	**Reject $H_{01.1}$**
R= 0.811, Adjusted R^2=0.657						

Table (4-11) above shows the results of simple linear regression for the impact of using the IoT Intelligence on the Quality of Service Availability in Royal Jordanian Airline from passenger's point of view.

The relationship between the independent variable **Intelligence** and the dependent variable **Quality of Service** was a strong significant relationship where the value of person correlation was equal to (0.811).

The beta coefficient reflects the impact value by the independent variable **Intelligence**; It was equal to (0.736) and significantly impact the dependent variable.

The value of adjusted R^2 was equal to (0.657), represents the amount of variation observed in the quality of service and explained by the independent variable **Intelligence** which can explain 65.7% of the change in the dependent variable **Quality of Service** and this is considered a big percentage.

The t value (26.915) was significant because the related sig(t) value (0.000) less than (0.05), which means that the null hypothesis is rejected, so there is a statistically significant impact of IoT Intelligence on quality of service in Royal Jordanian Airline from passenger's point of view at the level of significance ($\alpha \leq 0.05$).

Testing the Second Sub Hypothesis

$H_{01.2}$: There is no impact of using IoT Connectivity on quality of service in Royal Jordanian Airline from passenger's point of view at the level of significance ($\alpha \leq 0.05$).

$H_{a1.2}$: There is an impact of using IoT Connectivity on quality of service in Royal Jordanian Airline from passenger's point of view at the level of significance ($\alpha \leq 0.05$).

Table (4-12) simple linear regression for testing the impact of using IoT Connectivity on the Quality of Service Availability in Royal Jordanian Airline from passenger's point of view

Independent Variable	(β) Value	t value	Sig. t	F value	*p*-value Sig. F	Hypothesis Support
Connectivity	0.873	25.799	0.000	665.610	0.000	Reject $H_{01.2}$
R= 0.799, Adjusted R^2=0.638						

Table (4-12) above shows the results of simple linear regression for the impact of using the IoT Connectivity on the Quality of Service Availability in Royal Jordanian Airline from passenger's point of view.

The beta coefficient was equal to (0.873) and it is a huge impact value by the independent variable **Connectivity**, and significantly impact the dependent variable.

Also the relationship between the independent variable **Connectivity** and the dependent variable **Quality of Service** was a strong significant relationship where the value of person correlation was equal to (0.799).

The value of adjusted R^2 was equal to (0.638), represents the amount of variation observed in the quality of service and explained by the independent variable **Connectivity** which can explain 63.8% of the change in dependent variable **Quality of Service** and this is considered a big percentage.

The t value (25.799) was significant because the related sig(t) value (0.000) less than (0.05), which means that the null hypothesis is rejected, so there is a statistically significant impact of using IoT Connectivity on quality of service in Royal Jordanian Airline from passenger's point of view at the level of significance ($\alpha \leq 0.05$).

Testing the Third Sub Hypothesis

$H_{01.3}$: There is no impact of suing IoT Dynamic Nature on quality of service in Royal Jordanian Airline from passenger's point of view at the level of significance ($\alpha \leq 0.05$).

$H_{a1.3}$: There is an impact of using IoT Dynamic Nature on quality of service in Royal Jordanian Airline from passenger's point of view at the level of significance ($\alpha \leq 0.05$).

Table (4-13) simple linear regression for testing the impact of using IoT Dynamic Nature on the Quality of Service Availability in Royal Jordanian Airline from passenger's point of view

Independent Variable	(β) Value	t value	Sig. t	F value	*p*-value Sig. F	Hypothesis Support
Dynamic Nature	**0.755**	**28.175**	**0.000**	**793.824**	**0.000**	**Reject $H_{01.3}$**
R= 0.824, Adjusted R^2=0.678						

Table (4-13) above shows the results of simple linear regression for the impact of using the IoT Dynamic Nature on the Quality of Service Availability in Royal Jordanian Airline from passenger's point of view.

The value of adjusted R^2 was equal to (0.678), represents the amount of variation observed in the quality of service and explained by the independent variable **Dynamic Nature** which can explain 67.8% of the change in dependent variable **Quality of Service** and this is considered a big percentage.

The relationship between the independent variable **Dynamic Nature** and the dependent variable **Quality of Service** was a strong significant relationship where the value of person correlation was equal to (0.824).

The beta coefficient was equal to (0.755) and it is a strong impact value by the independent variable **Dynamic Nature**, and significantly impact the dependent variable.

The t value (28.175) was significant because the related sig(t) value (0.000) less than (0.05), which means that the null hypothesis is rejected, so there is a statistically significant impact of IoT Dynamic Nature on quality of service in Royal Jordanian Airline from passenger's point of view at the level of significance ($\alpha \leq 0.05$).

Testing the Fourth Sub Hypothesis

$H_{01.4}$: There is no impact of using IoT Enormity on quality of service in Royal Jordanian Airline from passenger's point of view at the level of significance ($\alpha \leq 0.05$).

$H_{a1.4}$: There is an impact of using IoT Enormity on quality of service in Royal Jordanian Airline from passenger's point of view at the level of significance ($\alpha \leq 0.05$).

Table (4-14) simple linear regression for testing the impact of using IoT Enormity on the Quality of Service Availability in Royal Jordanian Airline from passenger's point of view

Independent Variable	(β) Value	t value	Sig. t	F value	*p*-value Sig. F	Hypothesis Support
Enormity	0.835	35.220	0.000	1240.42	0.000	Reject $H_{01.4}$
R= 0.876, Adjusted R^2=0.767						

Table (4-14) above shows the results of simple linear regression for the impact of using the IoT Enormity on the Quality of Service Availability in Royal Jordanian Airline from passenger's point of view.

The t value (35.220) was significant because the related sig(t) value (0.000) less than (0.05), which means that the null hypothesis is rejected, so there is a statistically significant impact of using IoT Enormity on quality of service in Royal Jordanian Airline from passenger's point of view at the level of significance ($\alpha \leq 0.05$).

The relationship between the independent variable **Enormity** and the dependent variable **Quality of Service** was a strong significant relationship where the value of person correlation was equal to (0.876).

The beta coefficient was equal to (0.835) and it is a huge impact value by the independent variable **Enormity**, and significantly impact the dependent variable as the probability of t statistics was (0.000) less than (0.05).

The value of adjusted R^2 was equal to (0.767), represents the amount of variation observed in the quality of service and explained by the independent variable **Enormity** which can explain 76.7% of the change in dependent variable **Quality of Service** and this is considered a big percentage.

Testing the fifth Sub Hypothesis

$H_{01.5}$: There is no impact of using IoT Sensing on quality of service in Royal Jordanian Airline from passenger's point of view at the level of significance ($\alpha \leq 0.05$).

$H_{a1.5}$: There is an impact of using IoT Sensing on quality of service in Royal Jordanian Airline from passenger's point of view at the level of significance ($\alpha \leq 0.05$).

Table (4-15) simple linear regression for testing the impact of using IoT Sensing on the Quality of Service Availability in Royal Jordanian Airline from passenger's point of view

Independent Variable	**(β) Value**	**t value**	**Sig. t**	**F value**	***p*-value Sig. F**	**Hypothesis Support**
Sensing	**0.583**	**21.685**	**0.000**	**470.226**	**0.000**	**Reject $H_{01.5}$**
R= 0.745, Adjusted R^2=0.554						

Table (4-15) above shows the results of simple linear regression for the impact of using the IoT Sensing on the Quality of Service Availability in Royal Jordanian Airline from passenger's point of view.

The relationship between the independent variable **Sensing** and the dependent variable **Quality of Service** was a strong significant relationship where the value of person correlation was equal to (0.745).

The beta coefficient reflects the impact value by the independent variable **Sensing**, It was equal to (0.583) and significantly impact the dependent variable.

The value of adjusted R^2 was equal to (0.554), represents the amount of variation observed in the quality of service and explained by the independent variable **Sensing** which can explain 55.4% of the change in the dependent variable **Quality of Service** and this is considered a medium percentage..

The t value (21.685) was significant because the related sig(t) value (0.000) less than (0.05), which means that the null hypothesis is rejected, so there is a statistically significant impact of

using IoT Sensing on quality of service in Royal Jordanian Airline from passenger's point of view at the level of significance ($\alpha \leq 0.05$).

Testing the Sixth Sub Hypothesis

$H_{01.6}$: There is no impact of using IoT Diversity on quality of service in Royal Jordanian Airline from passenger's point of view at the level of significance ($\alpha \leq 0.05$).

$H_{a1.6}$: There is an impact of using IoT Diversity on quality of service in Royal Jordanian Airline from passenger's point of view at the level of significance ($\alpha \leq 0.05$).

Table (4-16) simple linear regression for testing the impact of using IoT Diversity on the Quality of Service Availability in Royal Jordanian Airline from passenger's point of view

Independent Variable	(β) Value	t value	Sig. t	F value	*p*-value Sig. F	Hypothesis Support
Diversity	0.885	33.846	0.000	1145.56	0.000	Reject $H_{01.6}$
R=0.868, Adjusted R^2=0.752						

Table (4-16) above shows the results of simple linear regression for the impact of using the IoT Diversity on the Quality of Service Availability in Royal Jordanian Airline from passenger's point of view.

The beta coefficient was equal to (0.885) and it is a huge impact value by the independent variable **Diversity**, and significantly impact the dependent variable.

Also the relationship between the independent variable **Diversity** and the dependent variable **Quality of Service** was a strong significant relationship where the value of person correlation was equal to (0.868).

The value of adjusted R^2 was equal to (0.752), represents the amount of variation observed in the quality of service and explained by the independent variable **Diversity** which can explain 75.2% of the change in dependent variable **Quality of Service** and this is considered a big percentage.

The t value (33.846) was significant because the related sig(t) value (0.000) less than (0.05), which means that the null hypothesis is rejected, so there is a statistically significant impact of IoT Diversity on quality of service in Royal Jordanian Airline from passenger's point of view at the level of significance ($\alpha \leq 0.05$).

Testing the Seventh Sub Hypothesis

$H_{01.7}$: There is no impact of using IoT Security on quality of service in Royal Jordanian Airline from passenger's point of view at the level of significance ($\alpha \leq 0.05$).

$H_{a1.7}$: There is an impact of using IoT Security on quality of service in Royal Jordanian Airline from passenger's point of view at the level of significance ($\alpha \leq 0.05$).

Table (4-17) simple linear regression for testing the impact of using IoT Security on the Quality of Service Availability in Royal Jordanian Airline from passenger's point of view

Independent Variable	**(β) Value**	**t value**	**Sig. t**	**F value**	***p*-value Sig. F**	**Hypothesis Support**
Security	**0.880**	**33.818**	**0.000**	**1143.64**	**0.000**	**Reject $H_{01.7}$**
R= 0.868, Adjusted R^2=0.752						

Table (4-17) above shows the results of simple linear regression for the impact of using the IoT Security on the Quality of Service Availability in Royal Jordanian Airline from passenger's point of view.

The t value (33.818) was significant because the related sig(t) value (0.000) less than (0.05), which means that the null hypothesis is rejected, so there is a statistically significant impact of using IoT Security on quality of service in Roya l Jordanian Airline from passenger's point of view at the level of significance ($\alpha \leq 0.05$).

The relationship between the independent variable **Security** and the dependent variable **Quality of Service** was a strong significant relationship where the value of person correlation was equal to (0.868).

The beta coefficient was equal to (0.880) and it is a huge impact value by the independent variable **Security**, and significantly impact the dependent variable as the probability of t statistics was (0.000) less than (0.05).

The value of adjusted R^2 was equal to (0.752), represents the amount of variation observed in the quality of service and explained by the independent variable **Security** which can explain 75.2% of the change in dependent variable **Quality of Service** and this is considered a big percentage.

Chapter Five

Results and Recommendations

5.1 Descriptive Results

5.2 Hypothesis Results

5.3 Recommendations

Chapter Five

Results and Recommendations

5.1 Descriptive Results

- The values of means and standard deviation, for the independent variable (IoT) show that the sample responses ranged between (3.73- 4.10). The “Connectivity” factor recorded the highest mean among the factors being rated (by the study sample) as it ranked the first by a mean of (4.1032) while the factor “Sensing” was the least factor that was addressed as it recorded the least mean (by the study sample) (3.7365). The overall assessment degree of the independent variables was rated by a mean of (3.9374). This value expresses a high level of agreement among the study sample.
- The values of means and standard deviation, for the Quality of Service. Statement the application (check-in, frequent flyer, flight information, and boarding) is protected software." was the most item being rated by the study sample as it ranked the first by a mean of (4.04) while statement no. 3 which states " The passenger can rely on the application to manage his/her reservations and travel procedures any time" was the lowest item being rated by the study sample as its mean was the least (3.89).The overall assessment degree of (Quality of Service) was rated by a mean of (3.9603). This value expresses a high level of agreement among the study sample.
- The sample characteristics results where the respondents nationalities were from 11 different countries but the majority from Jordanian nationality, that’s because the most of Royal Jordanian passengers are Jordanian citizen and the questionnaire distributed in

Queen Alia International Airport and Royal Jordanian sales offices for passengers whose use mobile application and self-check-in.

5.2 Hypothesis Results

- There is impact of using IoT at the significant level ($a \leq 0.05$) on Quality of Service.
- There is a significant impact of using IoT dimensions (Intelligence, Connectivity, Dynamic Nature, Enormity, Sensing, Diversity and Security) on quality of service in Royal Jordanian Airline from passenger's point of view, at the level of significance ($\alpha \leq 0.05$).
- There is an impact of using IoT Intelligence on quality of service in Royal Jordanian Airline from passenger's point of view at the level of significance ($\alpha \leq 0.05$).
- There is an impact of using IoT Connectivity on quality of service in Royal Jordanian Airline from passenger's point of view at the level of significance ($\alpha \leq 0.05$).
- There is an impact of using IoT Dynamic Nature on quality of service in Royal Jordanian Airline from passenger's point of view at the level of significance ($\alpha \leq 0.05$).
- There is an impact of using IoT Enormity on quality of service in Royal Jordanian Airline from passenger's point of view at the level of significance ($\alpha \leq 0.05$).
- There is an impact of using IoT Sensing on quality of service in Royal Jordanian Airline from passenger's point of view at the level of significance ($\alpha \leq 0.05$).

- There is an impact of using IoT Diversity on quality of service in Royal Jordanian Airline from passenger's point of view at the level of significance ($\alpha \leq 0.05$).
- There is an impact of using IoT security on quality of service in Royal Jordanian Airline from passenger's point of view at the level of significance ($\alpha \leq 0.05$).

The research came to a conclusion that quality of services has become more enhanced with the IoT and its application. Not isolated from any other field of business, aviation now a days have a great reliance on the IoT and its application. The passengers by using the online application found out that their travel journey, starting from buying the ticket up till boarding the aircraft, have become much easier and met their needs and expectations.

Mainly, in specific, the research concern was Royal Jordanian Airlines and the services it presents through its application. The researcher concluded that the application, as per the passengers, was of a great help, however it needs certain updates and some other features to be added in order to meet the full demand of customers.

The result of the study showed that Connectivity factor is the main axis of IoT and plays an important role in improving services quality in Royal Jordanian Airline leaving a high impact compared to other dimensions appeared in Simiscuka, et.al. study, (2017), enabling it to connect IoT to many applications.

In Another hand, the study results pertaining to the Sensing dimension accorded with Islam, et.al., (2015) study, which uses a wide variety of applications that share in revolution in whole domain and redesigning its aspects, either social or economic.

And agreed with Ickin et.al., (2012) the use of mobile applications and services in our daily life activities, to support our needs for information, communication or leisure.

Security dimension plays a significant role in quality of service which corresponds with Khodkari, et.al., (2016) showing that the most dominant factor for securing passengers data, which make passenger secured when using the IoT application which is reflected on the service quality.

In relation to diversity dimension, the study somewhat agreed with Kim(2016) study as diverse devices are connected within the existing internet infrastructure and through intelligent social applications, which implement intelligence in application. It also accorded with zhao, et.al., (2018) where diversity is a crucial dimension that has a strong effect on service quality in aviation and other fields such as healthcare, smart home, smart city, etc. which most of developed countries apply IoT.

The study agreed with Giang, et.al.,(2016) paper in that IoT devices have a Dynamic dimension and5 showed that the new breed of data and resources looks promising. Building an application in such a large scale of IoT systems is a difficult task due to the distributed and dynamic natures of entities involved, such as sensing, actuating devices, people and computing resources.

5.3 Recommendations

After the perfection of the study, it has come to a point to outline certain recommendations:

- Mainly the study recommends to urge passengers, where they seek for quality of service, to resort to the IoT applications for the use and at the same time provide their feedback if founded for the sake of improvement.
- The research recommends that Royal Jordanian airline should focus on the aspects of IoT that been developed and confirmed during this study to have impact on service quality, by setting of applications through which they present a service with quality which will help to attract more customers.
- The research affirms that the data or any personal information is highly secured by the nature of the IoT applications which makes it reliable to be used by any end user. And clearly outlines that the IoT are dynamic in the sense that it is accessible at all times and available at any place which ultimately reflects on the quality of service presented.
- The research states that the internet applications have a diverse nature as they are almost used in all fields. End users have the luxury of having this merit in any business. Also in specific, Aviation sector will gain the benefit of that in their promotional and financial plans.
- The research recommends that any airline must have a set of applications through which they present a service with quality which will help to attract more customers, improve their image and elevate their performance.
- As the research main stream is the study of Impact of using IoT on Quality of Service for Royal Jordanian Airline , the researcher recommends that the company to add a special feature on Their RJ application , mini Google map for the airport, to guide passengers to

the immigration point, food court , boarding gates and etc. after finishing the check-in process.

- The research recommends the researchers to investigate and focus more on the IoT and its impact on customer satisfaction as being part and partial of the quality of service as the studies that dealt with that issue is somewhat not enough.
- Also it is recommended applying this model on another population in different industries such as health care companies.
- For any future study, it is recommended analyzing a larger sample to broadly cover more passengers.

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Appendices

Appendix (1)

The Arbitrators of the Questionnaire

No.	Name of Arbitrator	University
1	Prof. Ahmad Ali Saleh	Middle East University
2	Prof. Heba Nasser Aldien	Middle East University
3	Dr. Samir Al jabali	Middle East University
4	Dr. Abdel Aziz Sharabati	Middle East University
5	Dr. Amjad Twaiqat	Middle East University
6	Dr. Ahmed Al sukkar	Middle East University
7	Dr. Mohammed Shkoukani	Applied Science University
8	Dr. Rawan Abu Lail	Philadelphia University
9	Dr. Mohammed Taye'a	Philadelphia University
10	Dr. Maram Bani Younes	Philadelphia University

Appendix (2)

The Questionnaire

Dear passenger

Greeting,,,

As a requirement to obtain a Master degree in Electronic Business (EB) from the Middle East University, the researcher seeks to conduct a study aiming to recognize the "**The Impact of Internet of Things on quality of service in Royal Jordanian Airline from Passengers point of view**" targeting a sample from Royal Jordanian Airline passengers. For this purpose, as you are the tightly related to this, the researcher would appreciate you to thoroughly read the questioner and Mark a tick (√) next to the answer that reflects your opinion. It's worth mentioning that your feedback and views will have a resounding effect in aiding the researcher to serve the best interest of the scientific research, noting that all the adduced information will be classified and confidential.

Your Cooperation is highly respected and appreciated

Researcher: Hasan Shkoukani

Part one: personal information:

1- Gender:

- **Male**
- **Female**

2- Age:

- **Less than 18**
- **18-30**
- **31-45**
- **46-60**
- **Above 60**

3- Nationality:

- **Jordanian**
- **Other**

  Mention nationality please……

4- Education:

- **Bachelor degree or less**
- **Post graduate**

5- Type of smart phone software you use:

- **IOS**
- **Android**

- **Windows**
- **Black berry**

Part two: This part is related to the dimensions of the **Internet of Things** in terms of describing the factors that affect the quality of service in Royal Jordanian from passengers' point of view.

	Connectivity	**trongly Agree**	**Agree**	**neutral**	**disagree**	**Strongly Disagree**
1	The passenger can easily reach the applications (such as booking, frequent flyer, check-in, flight information) from anywhere.					
2	Updating the applications (reservation, frequent flyer, check-in, and flight information) does not affect the previously inserted passengers' information.					
3	Applications related to (reservation, frequent flyer, check-in, flight information) work on all Wi-Fi, 3G, and 4G networks.					
4	The application sends a notification (such as delay, updated flight information, etc.)					
5	Application used can connect to more than one system (such as booking, check-in, frequent flyer, flight information and boarding, etc.)					

Security		Strongly Agree	Agree	neutral	disagree	Strongly Disagree
1	Applications (Check-in, Frequent Flyer, Trip Information, and Boarding) are being updated regularly.					
2	Applications protect the personal information of the passengers.					
3	The application enables the entitled listed passengers only to use applications (check-in, frequent flyer, flight information, and boarding).					
4	The application contains several fields to be filled to verify the identity of the passenger.					
5	The application (check-in, frequent flyer, flight information, boarding) authenticate itself in the network once the passenger logs in.					
Diversity		**Strongly Agree**	**Agree**	**neutral**	**disagree**	**Strongly Disagree**
1	The application (check-in, frequent flyer, flight information, and boarding) can be used from mobile devices or tablet.					
2	The application can be installed on the Mobile or tablets and can be downloaded from different stores as well.					
3	The internet applications are being used in many fields (Aviation, Smart Homes, Smart Cities, etc.)					
4	Passengers can use the application(check-in , frequent flyer and flight information) in the Self check-in devices in the Airport					
5	The application contains several functions (reservation, check-in, frequent flyer, flights information, etc.)					

Intelligence		Strongly Agree	Agree	neutral	disagree	Strongly Disagree
1	Passengers using the application (check-in, frequent flyer, flight information, and boarding) can automatically manage their reservations for upcoming flights (seat number, meals, etc.)					
2	Passengers using application for boarding can use the barcode for the boarding system.					
3	The application automatically registers passengers in the frequent flyer program to add points.					
4	The application sends notification of preferred offers, flights, dates and discounts based on previous flights.					
5	The application makes record of the passengers' information and pattern of travel.					

Sensing		Strongly Agree	Agree	neutral	disagree	Strongly Disagree
1	The application enables passengers to locate their gates, favorite restaurants at the airport etc.					
2	Upon arrival, the application sends a notification to the passenger with the number of the baggage delivery belt.					
3	The application enables passengers to check-in through their fingerprint as per their booking.					
4	The application can guide passengers to the boarding gates, restaurants, and the service area like Google Map.					
5	The application contains links to other applications related to passengers (e.g., mobility applications, car rentals).					

Dynamic nature		Strongly Agree	Agree	neutral	disagree	Strongly Disagree
1	The Application (booking, check-in, frequent flyer, flight information, and boarding) makes the travel journey easier.					
2	The application responds directly to users with travel requests.					
3	The application (booking, check-in, frequent flyer, flight information, and boarding) is accessible at all times.					
4	The application accepts all types of credit cards					
5	Discounts can be obtained when using the application.					

Enormity		Strongly Agree	Agree	neutral	disagree	Strongly Disagree
1	Mobile applications can be used in many different areas (such as aviation, healthcare, smart home, etc.)					
2	The extensive use of the application (booking, check-in, frequent flyer, flight information, and boarding) improves the quality of service.					
3	The extensive use of the application (booking, check-in, frequent flyer, flight information, and boarding) saves effort.					
4	The Use of application (booking, check-in, frequent flyer, flight information, and boarding) is part of the Smart City.					
5	The application (booking, check-in, frequent flyer, flight information, and boarding) provides passengers with the needed information (number of flights, travel points earned etc.)					

Quality of Service		Strongly Agree	Agree	neutral	disagree	Strongly Disagree
1	The application (check–in, frequent flyer, flight information, and boarding) achieves efficient use of resources.					
2	Passengers can replace traditional ways and adapt to the application usage (check-in, frequent flyer, flight information, and boarding).					
3	The passenger can rely on the application to manage his/her reservations and travel procedures any time.					
4	The application can be used by all genres (age, gender, culture of background).					
5	The application (check–in, frequent flyer, flight information, and boarding) is protected software.					