An-Najah National University

Faculty of Graduate Studies

Readiness, Barriers and Drivers for Infrastructure Sharing: Framework for Mobile Operators in Palestine

By

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Dedication

بسم الله الرحمن الرحيم

﴿ يَرْفَعِ اللَّهُ الَّذِينَ آمَنُوا مِنْكُمْ وَالَّذِينَ أُوتُوا الْعِلْمَ دَرَجَاتٍ وَاللَّهُ بِمَا تَعْمَلُونَ خَبِيرٌ ﴾

الحمد لله الذي وفقنا لتقديم هذة الاطروحة ويسر لنا أمرنا ووهب لنا العلم النافع ويسر طريق العلم لنا.

الى معلم البشرية ومنبع العلم نبينا محمد (صلى الله عليه وسلم)

في ظل الصعاب التي واجهتني من عناء الدراسة والعمل والجد إني لاجد اليوم انا وقلمي حائرين في مدى القرطاس، أجد حلاوة اللحظة، ونشوة النصر، وثمرة الجهد والتعب.

الى من جرع الكأس فارغا ليسقنني قطرة حب

الى من لم تكل أناملة ليقدم لحظة سعادة

الى من حصد الاشواك عن دربي ليمهد لي طريق العلم

الى القلب الكبير والدي العزيز إياد عنبوسي

الى التاج الذي أزين به رأسي الى ينبوع الحنان والامان

الى القلب الناصع بالبياض أمي الغالية ريما

الى أحبتي وسندي أخوتي مجدي ومعتز وغاليتي اختي منار و اللؤلؤه الصغيرة لورين

الى روح جدتي الطاهرة خولة

الى الذين كانوا عونا لنا في بحثنا هذا ونورا يضيء الظلمة التي كانت تقف أحيانا في طريقنا (أساتذتي)

وأخص بالذكر أستاذي العزيز المقتدر الدكتور سعد طربية الى كل ما قدمه من دعم وإرشاد لي طوال مسيرتي التعليمية

الى المهندس القدير احمد قشوع الذي قدم لي الكثير من المساندة والدعم

الى من انسني في دراستي وشجعني على مواصلة المسير (اصدقائي)

الى جميع من سبق أهديكم ثمرة جهدي

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الإقرار

أنا الموقعة أدناه، مقدمة الرسالة التي تحمل العنوان:

Readiness, Barriers and Drivers for Infrastructure Sharing: Framework for Mobile Operators in Palestine

أقر بأنّ ما اشتملت عليه هذه الرسالة إنما هو نتاج جهدي الخاص، باستثناء ما تمت الإشارة إليه حيثما ورد، وأنّ هذه الرسالة كاملة أو أي جزء منها، لم يُقدم من قبل للحصول على أي لقب أو بحث لدى أي مؤسسة بحثية أخرى.

<u>Declaration</u>

The work provided in this thesis unless otherwise referenced is the researcher own work and has not been submitted elsewhere for any other degree or qualification.

Student's Name: ملك اياد جلال عنبوسي	اسم الطالب:
Signature:	التوقيع:
Date: 22/12/2021	التاريخ:

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List of Abbreviations

Abbreviation	Description
2G	Second Generation
3G	Third Generation
ARPU	Average Revenue Per User
BSC	Base Station Controller
BTS	Base Transceiver Station
CAPEX	Capital Expenditure
EU	European Union Commission
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communications
ICT	Information and Communications Technology
IP	Internet Protocol
MIS	Mobile Infrastructure Sharing
MNO	Mobile Network Operator
MNS	Mobile Network Services
MTIT	Ministry of Telecom and Information Technology
MVNO	Mobile Virtual Network Operator
OPEX	Operational Expenditure
Qos	Quality of Service
RAN	Radio Access Network
RNC	Radio Network Controller
SIM	Subscriber Identification Module
STD	Standard Terms Determination
TOE	Technological, Organizational and Environmental
TRA	Telecommunications Regulatory Authority
TRAI	Telecom Regulatory Authority of India

TRC	Telecommunications Regulatory Commission
USA	United States of America

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Abstract

The information and communications technology (ICT) sector is one of the most important and rapidly evolving sectors in Palestine. ICT has a key role in the economic development of the country. Mobile network operators are constantly seeking to provide the highest quality services to their users and to achieve the highest possible profits. The existing operators in Palestine, which are Jawwal and Ooredoo, adopt a separate network model, rather than a shared network model. The aim of this research is to study the obstacles and motives related to the sharing of mobile networks infrastructure in Palestine, and to propose a framework for infrastructure sharing. To fulfil the aim of this research, the researcher adopted the qualitative approach. The needed data and information were collected through 20 semi-structured interviews that the researcher conducted with communications experts.

From the results of the research, the researcher concluded that the most influential drivers supporting the decision to engage in mobile infrastructure sharing in Palestine are reducing capital and operating expenses, in addition to launching mobile services faster for new operators, expanding network coverage and improving the quality of services. On the

other hand, the most influence barriers were the absence of a regulatory framework that regulates the mechanisms and laws of infrastructure sharing, and the complications presented by the senior managers of mobile network operators and the lack of encouragement and support for employees to begin formulating strategies for mobile infrastructure sharing. Furthermore, this research proposes a TOE framework for infrastructure sharing in Palestine. This is a pioneering study in the field of mobile phone communications, which was very well received by Palestinian mobile operators, especially with the granting of the 4G usage permit.

Chapter One

Introduction

1.1 Chapter Overview

This chapter provides a comprehensive description of the research, considering Palestine as the research context. Moreover, this chapter presents a general background on the research topic, the research problem, research questions and objectives, the research significance, and finally the structure of the thesis.

1.2 Study Background

Investing in Information and Communication Technology (ICT) is an essential and vital step towards attaining advanced productivity and economic growth [1]. Similarly, improving and developing the infrastructure of mobile network operators is a necessary step for attaining economic and social development. Numerous obstacles and challenges accompany the establishment of a mobile network infrastructure, such obstacles and challenges include the high investment capital and operational costs of the network, the development and maintenance costs of network, as well as other issues related to legal and regulatory matters [1]. Mobile network operators prefer to develop and use their own infrastructure rather than exploit the resources and excess capacity available from competing network operators [1]. This leads to higher costs

for operators to provide services, duplication of mobile networks, and waste of scarce network resources. Mobile Sharing (MS) is defined as having two or more mobile network operators coming together to share different components of their network hardware or software infrastructure for the purpose of reducing capital and operating costs and improving network performance [2]. This definition can be expanded broader to include an independent third party that provides leased infrastructure to mobile network operators, and such third party will be responsible for managing the infrastructure itself and the related sharing procedures [2]. The main objective of telecom infrastructure sharing is to conserve scarce resources, improve economic return on investment and develop services provided by network operators at competitive prices [3]. Mobile operators strive to provide their best services by adopting different types of network infrastructure sharing options in many countries around the world. Canada was one of the first countries to adopt infrastructure sharing, as it began sharing telecommunications infrastructure in the early fifties of the last century through the sharing of cable television infrastructure [4]. In the United States of America, the government supported the implementation of infrastructure sharing by granting infrastructure access authorization to cable television networks in the late 1970s [5]. As for mobile virtual networks, they emerged at the beginning of 1999. The first version of mobile virtual networks was established in the United States, where sharing began in cooperation with companies that have global brand name and an active commercial market, such as insurance companies and banks [6]. In

2001, the implementing of infrastructure sharing practices in the telecommunications sector started after mobile network operators were granted licenses to launch the third generation (3G) services in Europe [7].

Earlier successful mobile infrastructure sharing initiatives were witnesses in many countries around the world such as Germany, France, Hong Kong, and others.

In Germany, the European Union Commission (EU) approved 3G mobile network sharing in July of 2003. After allowing infrastructure sharing, T-Mobile entered into passive infrastructure sharing agreements with O2 mobile, and after a year O2 moved to roam nationwide [8].Upon the implementation of infrastructure sharing agreements for both O2 and T-Mobile, the European Union found that sharing contributed to improving the quality of communication services and coverage. It was clear that the positive impact of sharing on users was reflected through improving the quality of services, as well as reducing prices and increasing offers [8]. In France, The Telecommunications Regulatory Authority (TRA) supported mobile network operators to implement mobile infrastructure sharing by implementing sharing strategies starting from the time of the launch of the 3G services. The TRA defined five levels of infrastructure sharing; the first level included sharing sites and passive elements like sites, civil engineering, electrical supply, and air conditioning. The second level moved deeply in network structure including antennas and cable sharing [8]. The third level focused on base station sharing. The fourth level

studied Radio Network Controller (RNC) sharing. Finally, fifth level was sharing of backbone elements. Through these five stages, France was able to implement both active and passive infrastructure sharing amongst 3G operators, which are by four mobile operators [9].

In Hong Kong, the Ministry of Local Communications encouraged mobile operators to share their network infrastructure provided that certain commercial and technical terms and conditions are adhered to in order to avoid non-economic duplication of network resources and to preserve the aesthetics of the country [9]. In Bangladesh, passive infrastructure sharing is currently being promoted through the Infrastructure Sharing Guidelines approved by the Telecom Regulatory Authority. At the same time, the regulator is preparing an initial guide for active sharing [9]. In Jordan (2014), the Jordanian Ministry of Communications issued a decision to implement mobile infrastructure sharing and allow the implementation of national roaming for mobile network operators. The Jordanian Ministry of Communications is also preparing strategies and agreements for infrastructure sharing to avoid issues in the implementation of sharing [10].

In Israel (2015), the Israeli Ministry of Communications published network infrastructure sharing agreements and specific network sharing strategies and laws were established between Partner and HOT Telecom companies, and between Cellcom and Golan companies [11].

 In India, the telecom authority started encouraging mobile operators to share the mobile infrastructure, allowing both active and passive sharing.

Through the implementation of infrastructure sharing decisions, the network performance has clearly improved. Sharing infrastructure sites in both Mumbai and Delhi allowed operators to save 35% of the network's capital and operating expenses [12].

In New Zealand, the Commerce Commission of New Zealand had issued Standard Terms Determination (STD) for the specified service co-location on cellular mobile transmission sites in (2008). According to this standard, mobile operators must apply co-location on cellular mobile [12].

1.3 Problem Statement

Preparing an infrastructure is a major and challenging task for mobile communication services providers. In general, the provision of good communications resources is linked to a well-designed strategic framework [11]. Recently, mobile network infrastructure sharing has become an important topic and option for mobile network operators. Mobile operators must take into account many factors when starting to implement site infrastructure sharing. Among the most important points to consider are regulatory and environmental factors, as well as the price and quality of services [8]. Service providers are continuously seeking ways to improve coverage and services, and minimize costs as much as possible, this can be met by having new sites with new sharing technology to serve as biggest number of users to get maximum profit [1].

This same statement is present in Palestine, Jawwal and Ooredoo are the main Mobile Network Operators (MNO) in Palestine [13] [14], and each

company tries to attract as much customers as possible by providing various telecommunication services offers. In order to offer service coverage to the largest possible number of customers, Jawwal and Ooredoo are in constant competition to provide the best coverage and services possible through supplying areas that lack mobile network coverage of those that suffer from poor coverage with new communication site locations (network towers) to improve telecommunication services.

Nowadays, the competition between Jawwal and Ooredoo companies is increasing. Each company is trying to install new communication sites to provide better quality of service and to serve as much users as possible, and that is due to increasing population of Palestinians. The installation of new site costs each company thousands of dollars per year [15], therefore, both companies are looking for ways to reduce that cost and to effectively manage the required time and process. Some of those ways include terminating the employment of some employees or increasing the cost of the services provided to users. To reduce the cost of installing new sites as much as possible, Jawwal and Ooredoo should find practical solutions, and these solutions might include installing one site for both of them instead of paying full cost by each one of them for any new required site. For current installed sites, it is suggested to rent the already installed monopoles and other instructor hardware from each other.

In general, mobile infrastructure sharing in developed countries is managed through governmental legislations to ensure proper management and

sustainability [8]. Sharing practices have been identified, with guidelines for methods of adopting sharing, management strategies, and government laws to eliminate the negative effects from communication sector on environment and human to the lowest level of risk [8]. On the other hand, in developing countries such as Palestine, sharing practice are not receiving sufficient attention from the government and decision makers [8]. Although benefits gained from sharing can affect the economic, social and environmental aspects in the country, it still has many obstacles that must be studied and analysed within a conceptual framework that is commensurate with the nature of Palestinian environment. Thus, rising needs for adopting effective and efficient mobile infrastructure sharing practices that can minimize construction and maintenance costs, reduce environmental waste, and improve service performance [1].

1.4 Research Questions

Q1: What are the actual barriers related to mobile infrastructure sharing among mobile operators in Palestine?

Q2: What are the actual drivers of mobile infrastructure sharing among mobile operators in Palestine?

Q3: What is the readiness level of mobile network operators to adopt the proposed formwork of mobile infrastructure sharing?

Q4: What are the benefits that mobile network operators can gain from proposed infrastructure sharing with particular attention of cost reduction?

1.5 Research Objectives

Since this research aims to propose a framework to enhance high level of mobile infrastructure sharing management, the desired objectives that will be achieved are the following:

1. To define the actual barriers of mobile infrastructure sharing among the two Palestinian mobile network operators; Jawwal and Ooredoo.
2. To define the drivers of mobile infrastructure sharing among mobile operators in Palestine.
3. To assess the readiness level of mobile network operators to adopt the proposed Technological, Organizational and Environmental (TOE) framework of sharing available sites of Jawwal and Ooredoo.
4. To define benefits of infrastructure sharing with special focus on cost reduction.

1.6 Significance of the Research

This research provides an exploration of mobile infrastructure sharing practices in the context of the Palestinian communication sector through studying literatures of mobile infrastructure sharing practices and sustainability. In the context of a developing country, this research has a significant empirical contribution through the research design that focuses

on the use of the qualitative approach in collecting data from experts working in communication sector. This research also reveals the level of readiness for infrastructure sharing in Palestine. The main objective of the study is to design a proposed infrastructure sharing framework for mobile network operators in Palestine after identifying the motives and obstacles related to sharing. Since there is no available data about the nature of competition between the mobile network operators in Palestine and due to the privacy of network information, the research adopts an exploratory research approach [12], which enables the researcher to provide theoretical insights about competition in the context of infrastructure sharing between the mobile network operators. Accordingly, qualitative research is particularly suitable for addressing the research questions and objectives, as in this study [13]. The research design allows the generalization of the results related to Palestine to other developing countries that have not yet implemented infrastructure sharing. It must be notes that in previous literature many studies have used the same research methodology.

1.7 Thesis Structure

This thesis consists of five chapters and is structured as follows: Chapter one includes the background and introduction of the study, as well as the research problem, research questions and objectives, and the significance of the study. Chapter two provides a review of previous literature on infrastructure sharing in the telecom sector and its implementation in developed and developing countries, as well as presenting the benefits,

drivers, challenges, and barriers related to infrastructure sharing. Chapter three summarizes the study methodology used to attain the research objectives and questions. It also includes the research design, population and sampling design, and finally, the techniques used for data collection and analysis. Chapter four provides data analysis and the research results. Finally, chapter five provides a conclusion to the findings, and provides recommendations for future research work, as well as the limitations of this research.

1.8 Chapter Summary

This chapter sets forth an introduction to the study. It presents a background on the importance of mobile infrastructure sharing. Moreover, it identifies the research problem by focusing on the impact of sharing practices both on service providers and end users, followed by the research questions and objectives. Additionally, this chapter highlights the significance of the relationship between mobile infrastructure sharing and network performance, with focus on developing countries (Palestine) in the communication sector. Finally, this chapter provides the structure of the thesis.

Chapter Two

Literature Review

2.1 Chapter Overview

In this chapter, literature review, the researcher will provide an overview of mobile infrastructure sharing, as well as examples of successful implementation of mobile infrastructure sharing in different countries around the world, and their impact on sustainable performance in the communication sector. This chapter also includes an explanation if the possible scenarios for infrastructure sharing. Furthermore, the study presents the drivers and barriers of infrastructure sharing and provides a description of the conceptual framework and technological, organizational, environmental framework (TOE) framework.

2.2 Mobile Infrastructure Sharing

Infrastructure sharing is defined as an association between mobile operators that share mobile network infrastructure in different ways, whether in whole or in part, to provide better communication services to their users [16] [17]. Mobile network infrastructure includes the physical parts of the network, such as (cables, towers, radio parts, masts, fiber cables, cooling devices, columns, excavation works) and the non-physical parts of the network, such as (licenses, lease contracts, agreements). The aim of mobile infrastructure network sharing is to provide high quality services to users, and to reduce the capital and operational costs related to infrastructure, so

that companies are able to provide services at competitive and acceptable prices [18].

Infrastructure sharing opens new doors for mobile network operators as it allows them to switch to broadband technology. It enables operators to use virtual networks and cloud computing application. Sharing mobile network infrastructure makes broadband technology more accessible to all operators [18].

Mobile network infrastructure sharing may affect the nature of competition between operators, making it more intense. Moreover, the sharing of the mobile network infrastructure has a clear role in facilitating access to modern technologies in the telecommunications sector, in addition to increasing the quality of services provided to customers, and improving the economic situation of the country [19]. The number of mobile phone users around the world is increasing rapidly as out of every 100 adults around 90 residents own a mobile phone [20], which makes sharing mobile network infrastructure essential for providing high quality communication services that fulfill the needs of the largest number of users at the lowest possible costs [20]. Data received from the Palestinian Central Bureau of Statistics and the Ministry of Communications and Information Technology (MTIT) indicates that 8.3 million Palestinians subscribed to mobile communication services by the end of 2020 [20]. As of 2021, the number of base transceiver station (BTS) in Palestine was about 22,000. According to projections, Palestine will need 30,000 additional BTSs by 2029 [20].

Deployment of mobile networks requires significant investments to make these networks available to all customers, and these investments are recovered by the additional costs that are reflected on the prices of the services paid by the users. As a result, and to avoid rapid increase in the cost of services, operators started to search for new strategies that enable them to provide services to their customers with high quality while maintaining reasonable prices that enable them to keep their current users and target new users [21].

Recently, mobile network operators around the world have started to invest in infrastructure sharing in order to improve network performance, coverage and quality of services provided to users, while reducing capital and operational costs of deploying mobile networks infrastructure and preventing duplication of network operators' sites [22].

Infrastructure sharing contributes to saving time and effort for service availability in areas where communication services have not yet been provided [19]. Sharing actually plays role in reducing the number of antenna used, which has a positive impact on the environment; first by reducing energy used and carbon footprint of mobile networks, and second, by allowing for a more aesthetic and civilized country view [19].

2.3 Infrastructure Sharing Types

The different types of infrastructure sharing can be classified according to models [19] forms, types [18] and kinds [21]. In reference to previous studies, there is no definitive definition of mobile infrastructure sharing. In general, in most cases, infrastructure sharing has been defined under one main definition, which is sharing of more than one operator in one network infrastructure regardless of the benefit to the network operators and the users [22]. There are two main types of mobile infrastructure sharing, active sharing and passive sharing [23].

2.3.1 Active Infrastructure Sharing

Active infrastructure sharing involves sharing the most sensitive parts of the network in terms of electronic infrastructure and facilities, including spectrum frequencies, antennas, fiber cables, microwave equipment, radio equipment, power station cables, radio access controller (RNA), wireless access networks, base station controller (BSC) radio control and routing devices, in addition to transmitting and receiving stations, etc. This type of infrastructure sharing is less widespread and less applied around the world because of the deeper sharing of multiple parts of the network, which makes the sharing process more complex. Active infrastructure sharing is an advanced technology model that involves the mutual sharing of numerical components of the network not only of the passive elements, but also of the active elements of the network. Active sharing requires more

robust and thoughtful planning, with efforts deployed to accommodate all the needs of sharing capacities [23].

2.3.1.1 Radio Access Network Sharing

RNA sharing is one of the most important types of active infrastructure sharing, as it involves sharing all parts of the network; from frequency spectrums to antennas, and operating equipment and interconnections. When two or more network operators merge to become a single network shared by more than one operator, and at each access point, the main network is divided into several subnets. Decoupling reduces the logistical complexities of network control. This type is less applied around the world because of the difficulty of applying it on the ground [24].

Figure 2.1 below illustrates the sharing of the RAN between A and B mobile operators. In the following figure, the operators share all network components to access the main network, including antennas, radio equipment, sites, and cables. At the final access point, the network is divided and forked so that each operator works to organize the traffic of its users through the backbone network.
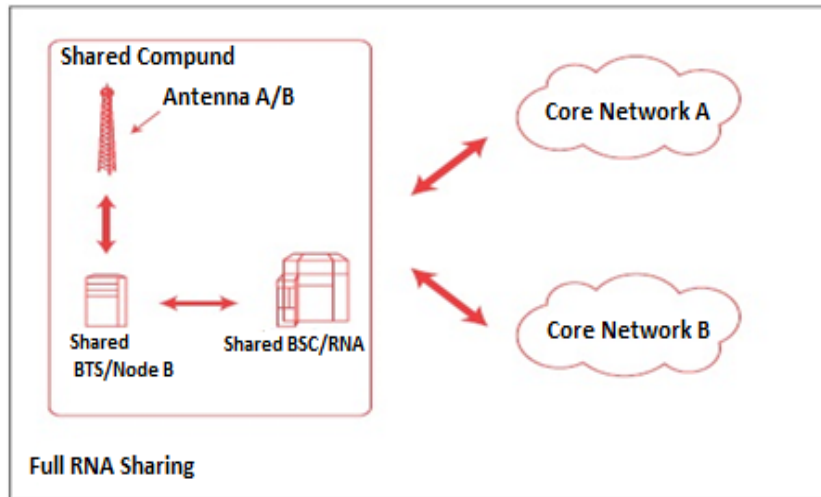
Figure 2.1: RAN sharing between two mobile operators [24].

2.3.1.2 Core Network Sharing

Core network sharing is also referred to as basic network sharing, and is a type of sharing that researches deeper into the details of the network. The other operator becomes a partner, which gives it the ability to access many key parts of the other operator's network. In general, the main network consists of billing platforms and the core of rational entities [25]. In this type of sharing, sharing can be applied at several levels according to the agreement between the operators, so that the sharing may be deep or superficial.

For example, operators can share the costs of network equipment identity registration so that both parties benefit from sharing. Through studying previous literature, it appeared that this type of sharing is not described in detail because there are different levels of application of such sharing, but the most clear definition of this type of sharing is open sharing that depends

on the decisions of operators and their desire to share some or all parts of the network [26].

2.3.1.3 Network Roaming

Active sharing also includes roaming through the networks of other operators. In this type of sharing there is no sharing of the involved operators' network components, rather, roaming only requires agreements and permissions that allow the operator to roam through competitors' networks. This type of sharing is applicable in most cases where operators of a particular network go to roam through another operator's network than the original network for a temporary period and then return to use the parent network.

This type has been implemented in most countries of the world as a basic need for the continuous use of mobile networks while roaming. Roaming can be categorized into three subcategories: national roaming, international roaming and intersystem roaming [27].

2.3.1.4 National Roaming

This type of sharing is applied in most countries of the world. It provides users with the freedom to move across the networks of competing operators in areas inside the country's borders. National roaming is only benefited from when the original network that serves the customer is not available, then roaming can be done through the host networks of available competitors [28]. With national roaming, operators can make up for the

lack of coverage and service using the same Subscriber Identity Module (SIM).

2.3.1.5 International Roaming

The characteristics of international roaming as a type of sharing is very similar to those of local roaming. However, the concept of international roaming expands to include the sharing of networks between competitors outside the borders of countries so that the country code is different from the other when roaming. This type allows the use of the basic network services in terms of initiating and receiving voice calls and text messages. This type of sharing is complex as the related mobile phone operates are on a completely different frequency band, and the mobile phones must support working in multiple and different domains [23].

2.3.1.6 Intersystem Roaming

Roaming between different systems of mobile operators is one of the most modern types of roaming, where the entire network is shared with competing operators. Each network operates with different standards, for example, one of them operates on a third generation system (3G) and the other operated on a Global System for Mobile Communication (GSM) system. This kind of combination of two different systems makes roaming more smooth to provide mobile communication services everywhere and at any time without interruption of calls regardless of the technology in which the network operates. This pattern contributes to rapidly improving the

level of returns, and reduces the subscribers' concern about network disconnection [21]. Intersystem roaming has many challenges on users and network terminals since they have to be able to support calls in both operators and maintain calls without cutting when changing between operators. This additional complexity may be reflected in the associated cost of network operations and maintenance in the short term, which may be later replaced with additional roaming revenue [29].

2.3.2 Passive sharing

Passive infrastructure sharing is quite different from active infrastructure sharing in terms of planning and implementation. Passive infrastructure sharing is the sharing of both physical and non-digital network components. This includes sites such as rooftops and open areas, masts, electrical connection to sites, backup batteries, air conditioning devices, poles, generators, and equipment cabinet for network components [24]. Passive sharing is easier to implement and mobile operators prefer to enter into this type of sharing. The most common forms of passive sharing are site sharing and mast sharing [24]. In this research, the focus will be on passive infrastructure sharing, since it is preferred to go towards realistic solutions that are closest to implementation and that are in line with the interests of the Palestinian telecommunications sector.

2.3.2.1 Site Sharing

Site sharing is also referred to as location sharing. It refers to sharing the location area where the operator will install communication equipment such as the roofs of buildings. This type is characterized by its ease and wide spread among mobile networks. While reviewing previous literature, the researcher found that many operators around the world follow this mode of sharing. The operators share the same location in terms of the geographical area or the space occupied by the mobile communication equipment, but each operator has its own mast to install its own network antenna. Each operator has its own telecommunication equipment cabinet that is responsible for protecting and maintaining it completely separate from other competitors. This style of sharing is suitable mostly for areas that need permanent planning due to the overcrowding of network sites and the lack of sites necessary for the network establishment [25].

2.3.2.2 Mast Sharing

Mast sharing, also known as tower sharing, is an advanced stage of location sharing, where sharing is not limited to location but also involves sharing the same mast. Figure 2.2 below shows mast sharing for mobile operators who share the same mast to install transceiver and antenna equipment [23]. Each operator installs its own antenna for its own network on one common mast. One of the things to keep in mind when performing this type of job is to consider the bearing capacity of the mast to accommodate the weight of the equipment that the operators will be mounting on the mast. Where each

mast differs from the other in terms of height, strength, durability, installation method and support.
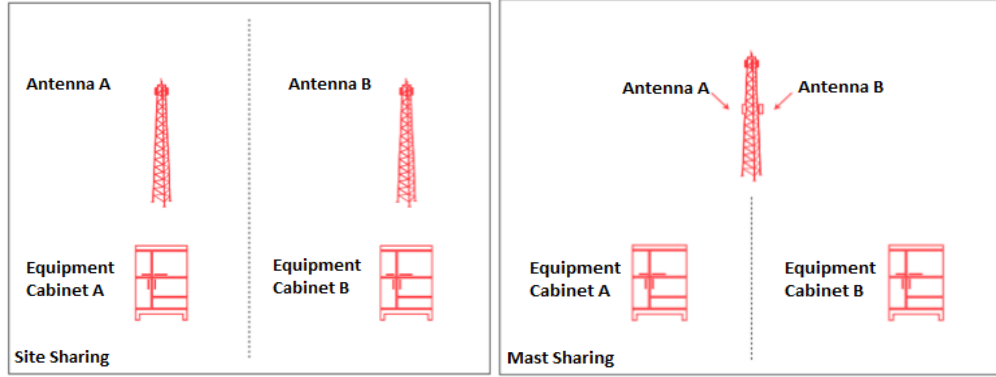
Figure 2.2: Site and Mast Sharing between two operators A and B [31].

2.4 Drivers of Infrastructure Sharing

Infrastructure sharing has numerous benefits, and these benefits affect mobile network operators, regulator and end customers. For operators, the main benefit is increasing investment by increasing the effectiveness of infrastructure sharing, as sharing leads to minimizing operational and capital costs.

There are various drivers that encourage mobile network operators to establish an infrastructure sharing relation. The leading driver for infrastructure sharing is saving costs related to network construction, operation, and maintenance. Sharing enables mobile network operators to avoid the challenges related to building new sites. It also allows for better use of scarce spectrum resources by merging existing networks [30]. Moreover, infrastructure sharing leads to the sharing of effort and costs of adding new towers and sparsely populated areas between different mobile operators as it is not feasible for the operator to set up a new

communication site that does not have enough users to make material profits.

Business motivations for mobile operators to share infrastructure vary, depending on sharing agreements and strategies. Each country has a special authority that regulates the telecommunications sector and grants permits and licenses for the implementation of mobile networks. Through previous studies, it was found that the most common patterns of infrastructure sharing is the passive sharing of mobile infrastructure, which includes many motives such as increasing returns on investment and reducing infrastructure and operational costs of the network [31]. Each type of infrastructure sharing has its own drivers depending on the nature of the sharing and the method of participatory implementation [27].

2.4.1 Site Sharing Drivers

Location sharing is rated as the most widely implemented type of infrastructure sharing. Although it is the simplest way to share, it offers effective benefits.

Mobile network operators use the mobile site sharing type because this type helps reduce basic and operational expenses. It speeds up the network deployment process by shortening the time needed to finalize agreements and permissions needed to create new sites. In many countries, such as India, sharing site infrastructure has caused a significant leap in terms of impact, and higher profits for operators [22]. Environmental and healthcare sectors are influenced by site sharing, since it reduces the energy

used and the carbon footprint of mobile network, and has positive effect in supporting an aesthetic and civilized country view. Moreover, operators often face rejection from the local residents when building new sites, thus, site sharing can be a practical solution to avoid elaborate negotiations. Using already existing sites can decrease the time, cost and headache associated with the need to look for suitable site locations. As for rural areas, the construction costs is much higher due to investment in access roads, power supplies, electrical work, and obtaining licenses for new sites [32].

2.4.2 Mast Sharing Drivers

Mast sharing for mobile networks is one of the most preferred types of sharing for operators, which has a direct impact on the basic expenses of new network sites, as mast costs constitute a high proportion of the expenses of new network sites. For telecommunication networks in India, it has been estimated that the percentage saved from mast sharing is approximately 33% of the basic costs [20] [22]. There are three different types in mast sharing;

"First, the use of existing sites and mast. This is possible when the co-location site already has a mast that is suitable for sharing another operator's equipment and antenna. In such case the operator can reduce CAPEX investment required. In this case new operator can rent mast from mast owner".

"The second variant is having an existing site that requires a new mast. The cost saving in this case depends on the type of site infrastructure and pricing structure employed. Mast have to be robust to carry new site antenna, so it may be need to change old mast with new heavy duty one".

"The third variant is needing a new site and mast: in this case, CAPEX can be saved when operators jointly pay for new site and mast".

2.4.3 RNA Sharing Drivers

One of the most important motivations for RNA sharing type is to reduce the size of the network's operating expenses. In European countries, economic indicators show that 28% of the operating expenses of mobile operators can be saved [27] [17]. In densely populated areas, operators need to increase the number of network sites to cope with the rapidly increasing number of users, and this constitutes a financial burden on operators, therefore, adopting RNA sharing is the best option for them [26].

2.4.4 Core Network Sharing Drivers

One of the most important motives for adopting core network sharing is to have the lowest possible network expenses. Therefore, many operators seek to implement this type of sharing in order to reduce basic and operational expenses. Through sharing, one network is used for more than one competitor, thus dividing the associated effort, time and costs [20].

2.4.5 Roaming Sharing Drivers

In general, all types of local and international roaming are of great importance in terms of the operator's commitment to providing the service to its users everywhere and at all times, and this is one of the most important drivers for roaming sharing, which reflects the quality of services provided by mobile operators [32].

2.5 Barriers of Infrastructure Sharing

There are many barriers and constraints to implementing mobile network infrastructure sharing. This includes both material barriers and non-material barriers. Although there are many drivers and advantages to implementing infrastructure sharing, the relation faces multiple obstacles delaying the sharing process [17].

2.5.1 Site and Mast Sharing Barriers

Prior to the implementation site sharing and mast sharing, operators must conduct a full study on the specifications of the network sites being shared. Masts differ from each other in terms of design, some are designed to carry specific weights that prevents overshoot, and some are intended to be installed on the roofs of the skyscrapers. Moreover, masts are distinguishes by their height. The physical specification of the masts is an obstacle to which logical solutions must be found. It is possible to check the bearing capacity of the mast before sharing or they can be completely replaced in

order to be able to carry the transmitting and receiving equipment of more than one operator sharing the same mast [19].

In the most crowded areas and in downtown locations, most network sites are installed on the roofs of buildings. One of the obstacles that mobile operators can face when using the sharing application is the lack of sufficient space to install the equipment of other operators due to the limited space available on the roofs of residential buildings. From previous experiences of sharing, the factor of residential buildings bearing the weight of communication tower equipment significantly influences decisions to share mobile network infrastructure [33].

For urban locations, operators are more concerned with the aesthetic effect, since the number and method of antenna installation and mast height must be taken into consideration. When the number of receivers and transmitters in a given location cannot be doubled due to sharing, the aesthetics can be at their worst. In such cases, mobile operators resort to the use of disguised communication sites, the outward appearance of which resembles street extensions and facilities. In Palestine, operators follow the same approach in some locations where operators face opposition from neighborhood residents to install communication towers for fear of harming residents' health [21].

2.5.2 RAN Sharing Barriers

RNA sharing in mobile networks can have negative impact on the quality of communication services (QoS); when more than one antenna are

combined, the signals are weakened, according to practical experiences with this type of sharing. Mobile operators strive to provide services of the best possible quality to users, so they must select the most appropriate method for infrastructure sharing. It is possible to use the RNA method to share the communication infrastructure in rural areas, as the weak signal strength does not affect the coverage achieved by the mobile operator [33]. The full impact of this will vary from one operator to another, according to different factors such as the frequency of operation. Other factors such as antenna development may mitigate the negative aspects on the medium and long term.

2.5.3 Core Network Sharing Barriers

In sharing the core network for mobile networks many barriers must be studied and avoided. Core network sharing includes all components of the main network and communication equipment, and this requires a lot of analysis that is necessary for the network of the other operator when sharing. Some equipment operate within a specific range that is completely different from that of other operators [17]. As for transmitting and receiving equipment, each operator develops its own network for newer technology with certain strategies that may conflict with other participants, each according to the budget approved for developing his own network.

2.5.4 Roaming Barriers

Digital roaming has become easy to implement as it does not require any tangible changes to the structure and installation of the shared networks. This type of sharing only requires agreements and permissions which are easily arranged between mobile operators. It was clear through many experiences that there are no major obstacles in this type of sharing, except that it is possible for one of the parties of a sharing agreement to breach the terms of the agreement, and this does not constitute a major obstacle towards the implementation of roaming around the world [28].

2.6 Mobile Telecommunication Services Operators in Palestine:

2.6.1 Palestine Cellular Communications Company (Jawwal)

The Palestine Cellular Communication Company, commercially known as Jawwal, is the first Palestinian cellular and wireless communications company. The Company, which is part of Paltel Group, launched its services in 1999 and offers its services both in the West Bank and Gaza Strip [34]. In 2001, Jawwal suffered from the Israeli occupation's control of the company's equipment. Jawwal extended lines of communication across the ocean to reach London to achieve mobile communication services to serve all its subscribers thousands of miles away from its headquarters [34]. By the first quarter of 2020, Jawwal had 5.3 million subscribers [34]. Where the share of Jawwal in the Palestinian cellular market is 75% of the Palestinian market [35], and it covers up to 98% of the West Bank and Gaza Strip [35] [36].

2.6.2 Ooredoo Palestine

Ooredoo Palestine is the second mobile network operator to launch in Palestine. Ooredoo launched in November 2009 [37], and is a member of the Ooredoo Group. Currently, the Company provides its services in the West Bank and Gaza. Ooredoo had 2.2 million subscribers by the end of 2020, a 28% market share, and has coverage up to 90% of the West Bank [37].

2.7 Regulatory Approval for Infrastructure Sharing

Infrastructure sharing is highly affected by regulatory measures as laws imposed by regulators, such as the ministry of communication, can make sharing mandatory for mobile operators. Regulators can provide facilitations that encourage operators to embrace infrastructure sharing by exempting operators from taxes or helping to design sharing strategies [22]. The regulatory body in a country can change the course of the deployment of mobile communications infrastructure, there are many countries around the world have made the decision to share mandatory, such as the United States of America. This research examines the role of the regulator in making the decision to share enforceable. As for network sharing regulations in Palestine, the Ministry of Telecommunication and Information Technology held a meeting with the two Palestinian mobile network operators to regulate the sharing of telecommunications infrastructure [23]. However, the meeting did not have any tangible results and the companies promised to deliberate this issue further and come up with a proposal for the Ministry of Telecom and Information Technology

(MTIT). Until this day, no advancements were made in this regards. Table 2.1 shows country examples of sharing agreements and regulator position due to sharing agreements. Table 2.1: Regulatory position for different sharing agreements.

Table 2.1: Regulatory position for different sharing agreements.

Country	Operators	Sharing Agreement	Regulatory Position
India	Jio,Vi,Bsnl,Airtel (all mobile operator)	Communication sites sharing agreements have been reached at a rate of between 30% - 40%. Sharing is based on the exchange of one site for another.	The Telecommunications Regulatory Authority approved the sharing of RNA-type mobile phone sites, in addition to the application of location and mast sharing in both Mumbai and Delhi.
Italy	TIM and Vodafone	On March 6, 2020, the European Commission allowed full control of the Italian telecom network (INWIT) by the two largest Italian companies (Telecom and TIM) [31].	There is no obligation for mobile network operators to sign infrastructure sharing agreements.
Brazil	Vivo, TIM, Oi, Movistar	Sharing was implemented by four major operators in Brazil for both active and passive types.	The government encouraged the implementation of infrastructure sharing, provided that the laws and regulations of the regulator are fully adhered to
Island	Arquiva	The regulator has authorized a third party to own and lease the mobile infrastructure to any operator to deploy the telecom services.	Passive sharing is permitted but not mandated.
Australia	Telstra and H3G	Commercially negotiated 3G site locations and RAN sharing	Regulator approved sharing of 3G RAN

2.8 Possible Scenarios for Infrastructure Sharing

Generally, mobile network operators design their mobile networks from planning and implementation to operation and optimization. So that each operator is responsible for the maintenance and development of their network later on. Since demographic and technological development began, many scenarios of mobile infrastructure sharing started to emerge. Through reviewing previous literature, the researcher reached four possible model scenarios for sharing between mobile operators.

2.8.1 The first scenario: Mobile Virtual Network Operators

Infrastructure and spectrum are set up in a given area and owned by one particular operator as shown in Figure 2.1(a), and the other operators do not own any resource in the network. They can benefit from the network as virtual operators, and since they do not own any component of the network, they can benefit from the network by renting resources from the main operator. This model has been successfully implemented in many countries around the world due to its simplicity and the benefits gained. Thus, applying infrastructure sharing in this case would be beneficial to subscribers for the availability of services, also for the main operator by gaining basic and operational expenses, as for other operators, the greater benefit will be in terms of speed of entry to the market and service availability at the lowest costs. This model is compatible with the traffic requirements in mobile networks, which probably cannot be met using only

the existing mobile infrastructure and the limited amount of network resources.

2.8.2 Second scenario: Use of Trusted Third Party Infrastructure

One of the most important models applied globally in sharing mobile infrastructure is having a trusted third party that provides infrastructure for mobile networks figure 2.1(b). The role of the third party is to be responsible for all hardware parts of the network; from providing network infrastructure to maintenance matters. Accordingly, operators who have spectrum licenses may enter into agreements in order to use the network. The benefit of the third-party model, which is used in many countries such as Spain, is significantly lower capital expenditures for operators by reducing network and hardware maintenance costs. It is also useful for operators who want to quickly provide their services in a specific geographical area. However, some studies indicate that operating expenses may increase due to the high costs of renting sites for extended periods of time.

2.8.3 Third Scenario: Unique Infrastructure Provider

In this scenario, only a single operator has deployed the entire network, including infrastructure and spectrum. The owning operator then rents part of its infrastructure to other interested operators. Figure 2.1 (c) below shows the mechanism of network sharing in this model. By using this sharing mechanism, operators can rent all network resources and get into

hard-to-reach areas faster and easier. Previous studies have found that the most important benefit that can be gained for leased operators is quick access to users. As for the operator who owns the infrastructure, the burden is likely to be greater in terms of depreciating and maintaining the infrastructure that is used by more than one party.

2.8.4 Fourth Scenario: Standalone

This is the traditional model for the deployment of mobile networks (Fig 2.3(d)). As each operator provides its infrastructure, spectrum and all its network equipment are completely separated from other operators. In this scenario, the MNOs have complete control over their network and are thus able to estimate the expenses for both network deployment and operation. In this study, the researcher will present an in-depth study of this model, which is currently adopted in Palestine, and which can be further developed.
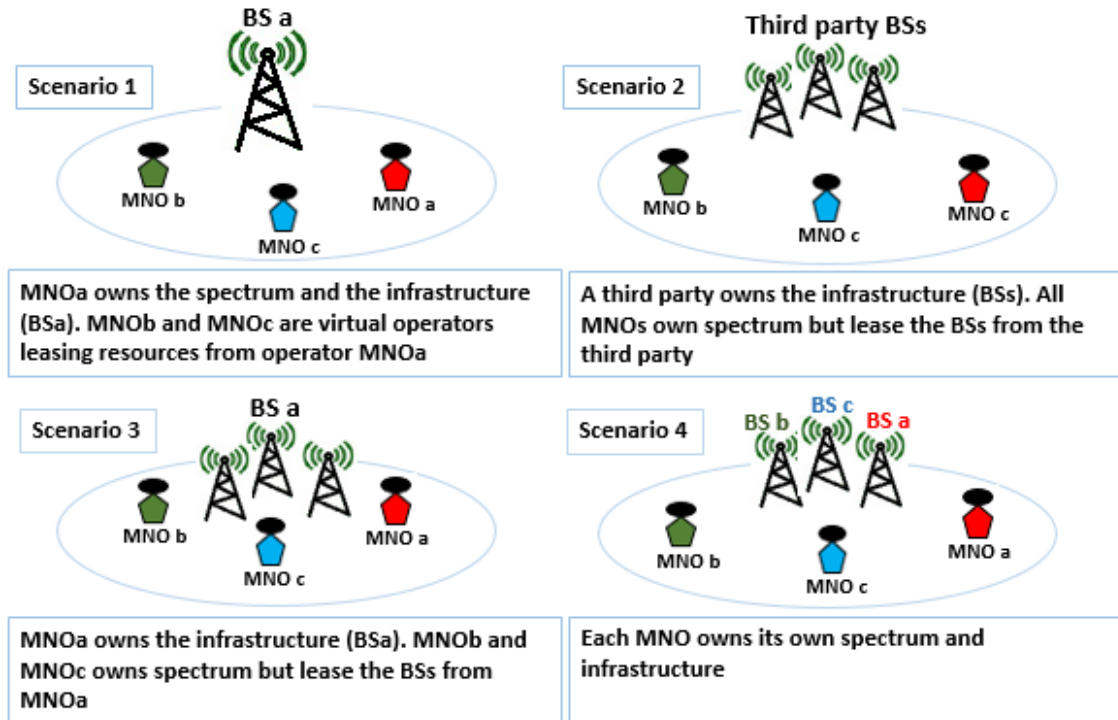
Figure 2.3: Multi-operator Mobile Network Architecture [29]

2.9 Environmental Impact of infrastructure sharing

The environmental impact of mobile phone networks is summarized in three main points [23]:

• Spread of masts and sites.

• Network Power consumption.

• Handsets mobile phone.

2.9.1 Spread of masts and sites.

One of the most visible environmental impacts of mobile phone networks is the wide spread of masts. In Palestine, the number of masts is increasing rabidly. This has a negative impact on the aesthetic view of the surrounding environment. Subscribers require operators to provide them with

connectivity in all regions, and at the same time, they oppose having an infrastructure to provide the service for aesthetic, health and environmental reasons. The situation is more evident in developed countries where mobile phone infrastructure poses a threat to the public concerned with the environment and the aesthetic appearance of the country. Some operators resort to using hidden network locations, so that users cannot recognize them as accessories are used to hide them. But these sites are characterized by their small size, as they are mostly suitable for sharing infrastructure. This provides operators with a challenging task as it requires them to provide the service while addressing the environmental concerns of the public such as the aesthetic appearance of the environment.

Through research and review of previous literature, the researcher found that by implementing mobile network infrastructure sharing, the number of sites across the country is reduced by sharing infrastructure, such as site sharing and mast, it is found that mobile operators may face the problem of the mast or site not bearing the weight of antennas and transceiver equipment. To solve this problem, operators have resorted to using antennas that support several technologies in the same antenna, which may be more expensive than the use of other technologies.

 In Palestine, mobile network operators with regard to specifications face many restrictions related to the use of antennas and transmitting and receiving equipment, which limits the ability of operators to choose the best types of communication equipment. Through this study, the researcher

will address the reasons for not applying infrastructure sharing and its positive impact on the environment.

2.9.2 Network Power Consumption

The infrastructure of any system requires the availability of energy. With regard to mobile phone networks in Palestine, the most important requirement for establishing a new site, especially in areas that are not provided with electricity services, is to provide the energy sources necessary to operate the site and related devices. Mobile operators are often required to provide thousands of active sites in multiple geographic areas.

From a legal and commercial point of view, operators must commit to providing the service Twenty-four hours a week (24/7), throughout the week without any interruption or network disruption. It is possible that the demand for services provided by operators at night will decrease, but it is difficult for operators to predict the consumption of the network and it is difficult for operators to make decisions related to reducing energy consumption by stopping some sites [38].

Mobile networks require a lot of energy to run for long periods of time, so the rate of energy consumption required to operate the infrastructure is huge. It results in carbon emissions, which are harmful to the environment. One report from Actix, a company that specializes in software solutions for mobile operators, states that "mobile networks consume 70 billion kWh of energy annually with an average site responsible for 15 tons of carbon emissions annually" [38].

According to the statistics of 2019, the use of energy by mobile networks represented 0.12% of the primary energy compared to the energy used for transportation and travel by 25% [30]. Through previous studies, it was found that sharing the infrastructure of mobile networks has positive effects on preserving the environment. Infrastructure sharing reduces the number of equipment needed to operate the site, which contributes to reducing energy consumption and carbon emissions [30].

2.9.3 Handsets Mobile Phone

The number of mobile phone subscribers has reached nearly seven billion subscribers around the world. With the development of communication technology, most subscribers acquire smart phones to access the network. This number is certainly rapidly growing as the population continues to grow [39]. Mobile handset manufacturers focus on developing new versions of mobile phones in cooperation with mobile operators in order to give customers an incentive to continue using mobile networks and enjoy the new features that are being added to mobile devices. According to Gartner reports, global mobile phone sales reached 955 million units in the third quarter of 2019 [21]. The rapid growth in the number of efficient mobile phones around the world has a huge impact on the environment, and this effect expands from the manufacturing process to the disposal of the product at the end of its life cycle. Although mobile phone operators are not involved in the manufacturing stage of mobile phones, they have a significant impact on the continuation of the manufacturing process.

Currently, old mobile handsets are being discarded when users decide to upgrade to newer devices. However, as an environmentally healthier alternative, old devices can be recycled to reduce the environmental impact of mobile handsets manufacturing and disposal process [32].

2.10 Conceptual Framework

A conceptual framework is an analytical tool that has many variations and contexts. They can be used in different classes of work to study different aspects where a comprehensive picture is needed. It is used to make conceptual distinctions and organize ideas. In this research, the TOE frame was used as a conceptual framework to study several factors at the level of the organization, technology and environment regarding mobile operators [40].

In conducting previous studies, different researchers adopted different conceptual frameworks. One of the most important frameworks is the TOE framework, which is characterized by its comprehensiveness and flexibility, as it is possible to change and switch between many external and internal factors surrounding the organization. The following table provides a summary of some previous studies and conceptual frameworks used by researchers [40].

Table 2.2: Previous Studies on Sharing Practices.

No	Authors (Year)	Sector	Methodology	Framework	Findings
1	Wanjiku [41]	Studies the factors effecting Enterprise Resource Planning (ERP) system sharing	Qualitative	Adopted TOE framework	The results of the study focused on two main aspects; the organizational structure and the weakness of the technology used
2	Lule [42]	Studies factors that affect the implementation of sharing mobile banking services	Qualitative	Used Technology Acceptance Model (TAM), to define factors that hinder or promote sharing strategy. The model focuses on understanding individual behavior rather than organization.	The benefit factors that the user expects to obtain from the service, in addition to the impact of supporting departments in the institutions
3	Ramagoffy [43]	Study cloud computing	Quantitative and qualitative approaches	Adopted TOE framework	Provided explanation and simplified meaning of top management practice to improve organization infrastructure.
4	Namisiko and Sawka [16]	The study focuses on researching the challenges of sharing telecommunications infrastructure.	Quantitative and qualitative approaches	Study lacks Existence of a framework that clarifies infrastructure sharing decisions	The challenges summarized by the research, cultural harmony. The pressure on the part of the stakeholders
5	Borgman [33]	Study factors influencing cloud computing adoption.	Quantitative and qualitative approaches	Used TOE Framework	The study revealed the role of cloud computing in improving the level of capital and operational expenditures

2.11 TOE framework constructs description

As the name indicates, the framework has three contexts; Technology (T), Organization (O) and Environment (E), with constructs that can be adopted depending on circumstances. This research adopts nine constructs (three for each context) [40].

2.11.1 Technological context

The technological context takes into account the internal and external technologies available and important to the company. Decisions regarding the adoption of modern technologies for a mobile operators depend on the operator's financial capabilities and regulatory decisions in the telecommunications sector applicable in the related countries. In Palestine, decisions regarding the adoption of modern technology related to mobile phone systems are very limited due to the restrictions and obstacles imposed by the occupying authorities on the state. While other countries around the world are able to adopt new technologies, Palestine needs many permissions and permits related to be able to implement such decision. For example, the third generation (3G) services for mobile communication first appeared around the world was in 2001, while Palestine was allowed to adopt the year 2018 due to restrictions imposed by the occupying authorities.

Technological developments greatly affect a mobile network operator's decision to adopt measures that help in the optimal use of the organization's

resources [40]. The subscribers' increasing demand for modern technological services pushes operators to search for faster and better ways to provide their service while maintaining reduced costs related to establishing new sites. According to previous studies, the impact of the technological aspect was clear on operators' decisions to adopt strategies for sharing mobile infrastructure. Additionally, operators must take into consideration the suitability of the technology used for operators who wish to share in terms of whether or not to share. In Palestine, the technology used by the existing operators is very similar, and this facilitates the decision of the sharing process.

2.11.2 Organizational Context

The context of an organization includes both the business environment, which is determined by external factors such as, financial, legal, social, cultural, organizational, etc., and the internal environment of the organization, which is determined by internal factors such as internal structures, resources, capabilities and governance [41]. The context of the organization also depends on the decisions of the top management in the organization.

Despite the fact that it is up to the senior management to adopt the decisions to share its mobile infrastructure, if the financial conditions of the operator is at its best, senior management will prefer not to adopt the infrastructure sharing in order to maintain its competitive advantage and the privacy of network information. However, if there is a decline in a

company's financial situation, then one of the first decisions adopted by mobile phone operators is to turn to infrastructure sharing as a method of reducing cost [42].

2.11.3 Environmental Context

The environmental context refers to the setting in which an operator conducts its business. The environmental context is affected by industry, competition, and interaction with government [30]. The economic conditions in a country directly affects the decisions made by mobile operators. In countries where the economic situation is declining, the demand of subscribers for mobile services will decrease, which leads to a decline in sales for operators, a decrease in their profits and an increase in operational costs [31]. In the former case, infrastructure sharing decisions are the best solution for mobile operators and constitute a good motivation for adopting sharing strategies.

As for competition, it was clear from previous studies that the competitive advantage possessed by participants in some important sites of high value greatly affects the decision to implement infrastructure sharing [43].

As for government decisions, the decision to share infrastructure is greatly affected by the laws that governments and regulators put in place in the country. As some governments make the decision to participate mandatory, such as Cyprus, and some are optional, such as Italy, and others are prohibited, such as the Netherlands [44]. Since the government is the one

who sets the legislation for sharing, it plays a major role in implementing such decisions [45].
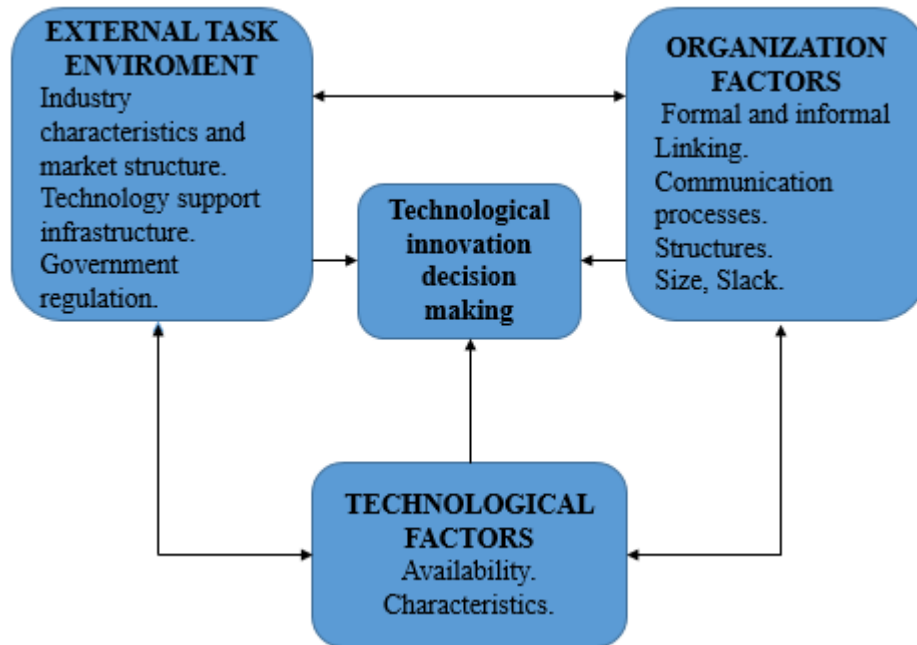
Figure 2.4. TOE framework [46]

2.12 Summary of Chapter

Based on the results of the literature review on mobile network infrastructure sharing, the following conclusions emerged. Research on the applications of mobile network infrastructure sharing has focused on developed countries and western societies specifically in the telecommunications sector. Where infrastructure sharing strategies in developing countries do not receive the same attention, as well as studying the drivers that affect the sharing implementations. Based on this literary gap, this study added evidence about the importance of implementing infrastructure sharing in developing countries, and shed light on the most important obstacles towards implementing infrastructure sharing through the proposed conceptual framework.

Chapter Three

Methodology

3.1 Chapter Overview

The main objective of this study is to propose a framework for TOE sharing, and assess the level of readiness of the Palestinian mobile network operators, Jawwal and Ooredoo, for the adoption of the proposed framework after finding and examining the drivers and challenges of sharing. Furthermore, the study aims to outline the benefits of infrastructure sharing, with special focus on cost reduction. In conducting the study, the researcher used the qualitative research method by conducting interviews to collect information from involved individuals from the two main operators in Palestine Jawwal and Ooredoo.

Through this research, the researcher aim to present the facts related to the research problem by following a systematic process of collecting data from different sources and analyzing it according to predefined criteria and methodology chosen by the researcher in proportion to the research data [47]. Adopting this type of research depends largely on the nature of the research questions and its objectives, as each research is unique with certain characteristics and design.

This chapter sets forth the methodology used by the researcher in conducting this research. It also presents the procedures used for data collection, methods of data analysis, the study design, the sampling

technique, the interviewing method, and the techniques used for data analysis in implementation of the qualitative approach. At the end, the chapter presents a chapter summary.

3.2 Research Types

In general, a research can be conducted by following three main steps which are determining the research question(s), collecting true data related to the questions, and finally, finding clear answers for the research questions [48]. According to the main objectives of a scientific research, research can be classified into three main types [48]; exploratory research, explanatory research and descriptive research.

The exploratory research is the type of research that the researcher uses when there is a lack of theoretical and practical information about the research idea [49]. It aims at exploring a new area of study and uses contextual study methods that are useful in recognizing the viewpoints regarding a specific subject and help to interpret information in the mind and perception states [49]. Such research is useful in defining issues and generating ideas for implementation [50]. Exploratory research is not intended to provide definitive evidence, but it allows for creating better understanding of the issue being explored [47].

Exploratory research provides general knowledge to explore the topic of the problem under study. It identifies the problem as well as investigates new information that would have been difficult to discover without using exploratory research [51]. Explanatory research is a type of research in which

a set of hypotheses related to the research are tested and the relationships between the variables of the research are checked [52]. Explanatory research is also referred to as causal research, and it aims at identifying the degree and nature of the triggering circumstances and resulting connections with a specific end goal [53]. Moreover, causal research can be used to perceive the effect of specific changes on existing standards, various processes, and so on.

Descriptive research is a research that expresses the conditions of the subject under study without addressing relationships and hypotheses [54]. This research type is concerned with how a matter could be interpreted as an effort to determine, represent or discern what it is [55]. This type of study aims to describe not only the examination of relationships, but it also systematically attempts to describe problems, situations or phenomena, to provide information about these communities, or to describe attitudes towards certain issues [56].

In this study, the researcher uses the exploratory research method. The researcher explores the barriers and drivers that effect the implementation of mobile network infrastructure sharing, and the readiness level of mobile network operator to adopt the proposed TOE framework of sharing available sites of Jawwal and Ooredoo in Palestine.

This study aims to explore the barriers and drivers that effects the implementation of mobile network infrastructure sharing and the readiness level of mobile network operator to adopt the proposed TOE framework of sharing available sites of Jawwal and Ooredoo in Palestine. It also

describes the benefits that mobile network operators can gain from infrastructure sharing with particular attention to cost reduction. As it has been clarified in the literature review chapter regarding the benefits of this study, since there are a few studies conducted on this topic, the exploratory research method is the best method to use in conducting this research, especially with the absence of similar studies in communication sector in developing countries.

3.3 Research Approach

Research approaches are the plans or procedures followed by the researcher in the preparation of the research, including all the stages that a research goes through, starting from collecting and analyzing data to drawing useful results [52]. There are several types of research, such as basic research and applied research, normal and revolutionary research, and quantitative and qualitative or mixed research.

The basic research is defined as the research that studies, investigates and interprets natural phenomena without providing practical explanations. It presents all possible solutions to the problem that is being studied [57]. Ordinary research is research in which the normal logical approach is carried out through clear stages and steps. While revolutionary research is the research related to the natural sciences and is carried out through conducting practical and applied experiments in laboratories in order to reach conclusions related to the problem under study [57].

Each scientific research has a specific approach followed by the researcher during the study preparation phase. Research is usually classified into two main approaches: quantitative and qualitative [58]. The researcher chooses between the two approaches based on two main factors: 1) the depth of knowledge of the topic of study, and 2) the selection and evaluation of the researcher the subject of the study [55].

A quantitative approach is compatible with the type of research that has an abundance of theoretical support for a phenomenon. In quantitative approach, specific hypotheses or theories are tested, and numerical data are collected to support or disprove the hypotheses. The data are collected using tools that measures attitudes such as questionnaires, and analyzed using the statistical and hypothesis testing software [59]. A quantitative research studies the underlying relationships between variables by following a set of systematic steps. To arrive at a logical analysis of the relationships between the variables under study, the researchers test their hypotheses and analyze the theories [60]. The theoretical approach is suitable for studies in which there is little theoretical information for a problem for the study problem, making it difficult to form a hypothesis for the research case. Such approach involves data collection, evaluation, presentation, and document writing qualitative methods that vary from the conventional quantitative approach. Moreover, the qualitative approach includes purposeful sampling, open data collection, text or image analysis, knowledge representation in figures and graphs, and subjective interpretation of the results. In the qualitative approach, the researcher

seeks to investigate a phenomenon or an issue from the perspective of participants.

As for data collection, for any type of study, data can be collected through methods such as observations or interviews with participants related to the subject of the study [52]. Qualitative research follows the explanatory approach because it relies on a non-objective perspective, and depends mainly on the follow-up and analysis of situations that emerge from human structures. It provides a deep understanding of phenomena and sequential events [61].

In many cases, the mixed method can be used. The mixed methods research is defined as a systematic integration or combining of quantitative and qualitative methods in a research study, to increase the understanding of a phenomenon and gaining a full and complex picture about it, also when using one type of approaches is not enough to answer and address the research question [62].

The qualitative data responses will be without predetermined and usually be open-ended responses, whilst quantitative data tends to be closed-ended responses such as questionnaires [63]. The mixed methods approach is a combination between the quantitative and qualitative data, and the inference of philosophical assumptions through a set of titles under study. The main objective of choosing this type of research is to provide more comprehensiveness to the study, where the quantitative approach provides useful numerical information and data for the study, while the qualitative

approach provides theoretical information that answers specific questions. [52].

Based on the foregoing definitions, and since the main aim of the research is to discover the obstacles and motives related to implementing mobile network infrastructure sharing in Palestine, this research adopts an exploratory qualitative approach. Throughout the study, the researcher provides extensive explanation of the factors and variables that affect the decision of adopting mobile infrastructure sharing [64].Therefore, the study explores the barriers and drivers for mobile sharing infrastructure, choices relating to adopting the proposed TOE framework of sharing available sites of Jawwal and Ooredoo companies.

3.4 Research Design

In conducting the research, the researcher adopted the qualitative approach associated with the exploratory study to enhance the research. In the exploratory research, the available data is accessed through reports on the events and processes related to the research problem. The aim of the study is to explore the mobile telecommunication sector to specify and study the reasons behind the delay by mobile operators in Palestine in implementing mobile network infrastructure sharing. Furthermore, the research will analyse the most important motivators and motives that support the adoption of infrastructure sharing decisions by relying fully on qualitative research due to the lack of digital information related to operators. This lack of digital information is due to several reasons, such as the

confidential nature of such information and due to the newness of the idea of implementing infrastructure sharing in Palestine, as it has never been applied before.

The research design includes a collection of analysis related to the topic of mobile operator infrastructure sharing, focusing on the role of telecom regulators in authorizing and supporting sharing decisions. Through various reports on mobile phone networks, some data that support research and enrichment was accessed, in addition to the academic literature on the topic of infrastructure sharing [65].

In order to obtain accurate information about the adoption of mobile infrastructure sharing, the researcher conducted semi-structured interviews with experts in the Palestinian mobile phone sector. In addition to people working in network parts supplier companies. In order to take into consideration all the stages that the construction of a new communication tower site for the mobile network is going through, civil engineers working in the field of designing and testing the readiness of sites for installing towers and transmitting and receiving equipment in all practical and technical aspects were also interviewed.

3.5 Research Procedure

Scientific research methodology is defined as a set of stages that scientific research goes through, in which the method of data collection and analysis, and the most important results obtained by the researcher [46]. As explained in chapter one of this research, the main objective of this

research is to define the actual barriers and drivers of infrastructure sharing among the two Palestinian mobile network operators; Jawwal and Ooredoo, and assess the readiness level of mobile network operator to adopt the proposed TOE framework of sharing available sites.

The methodology starts by defining the study problem, aim, purpose, scope of the study and formulate the research questions and objectives, then deep review of the literature of mobile network sharing practices to find the gap of the study. The second phase is start collecting data for the study. The next phase is to analyse collected data. After that, end up with results and recommendations.

For the purpose of data collection, the researcher conducted semi-structure interviews with experts in mobile network operators from the communication sector and contractors working in the same field. Afterwards, the collected data was analysed to propose a TOE framework of sharing available sites, and to compare costs before and after sharing.

Next, the researcher seeks to provide answers to the research question. The final step is developing a framework to help mangers working in communication sector for implementation such mobile sharing practices. Finally, the researcher presents the suggestions and recommendations related to the study.

Research Procedure chart

The research methodology flowchart, presented in Figure 3.1 below, illustrates the successive stages and steps of the research development, starting from defining the research problem up to arriving at the research results and formulating the related recommendations.

Problem statement	• Define the aims and scope of the study. • Define the research problem.
Methodology	• Decide the methodology to conduct the study.
Collect the data	• Conducted the interview and analyse it with thematic analysis approach.
Data analysis	• Analyse qualitative data. • Present the result and discussion.
Develop a framework	• Develop TOE framework.
Implication	• Present the recommendations, implications. • Present limitations and future work.

Figure 3.1: Research Procedure.

3.6 Sampling Method

The purpose of sampling is to obtain and clarify information about situations and events that focus on understanding the research problem [66]. In this research, the researcher conducted semi-structured interviews with experts working in the mobile sector and other individuals associated with the field including; Jawwal and Ooredoo companies as mobile operators, and ITEC and MTESC companies who are contractors in the field of networking.

In total, twenty respondents were interviewed. The number of individuals who were interviewed was sufficient for the researcher to obtain rich information for the research. The respondents held different positions in the named companies, and they were planning managers, optimization managers, deployment directors, technical advisor and civil and electrical engineer from contraction sector.

3.7 Data Collection

In this stage, a combination of primary and secondary data is collected. For the collection of primary data, the researcher uses the semi-structure interviews. While the source of secondary data was documents and reports obtained from mobile network operators, as well as site visits to some installed site locations.

3.7.1 Documents

In order to attain the research goals, a sample of site insulation mobile projects is selected, which has the role of providing sufficient statistical and

objective information about the life cycle costs of these projects mobile sites. The required data, especially data related to cost, has to be collected from official records and documents received from mobile operators. Due to the nature of the data and its sensitivity, the data related to costs will be an estimate of the actual costs.

3.7.2 Site Visits and Observations

Information regarding the nature of site location was observed though site visits. Those included visits to roof top sites and green field sites, due to the different foundation and accessories needed for each type. Several sites were visited, and the nature and specifications of sites were studied as each site has its own design in terms of its height, installment method, maximum weight of equipment, construction method, equipment cabinet design, and air conditioning equipment.

3.7.3 Interviews

Interviews are one of the main tools used in qualitative research, they are used as the data collection method. Interviews are especially appropriate when the researcher is looking for insights into people's feelings, opinions, emotions and experiences, sensitive cases, and privileged data related to a specific topic [67]. There are many advantages for such method, including depth of information, insights, requires simple equipment, informants' priorities, flexibility, high response rate and validity. On the other hand, using interviews has some disadvantages, for example, they are time

consuming, require data analysis, as well as some issues with reliability, interviewer effect, invasion of privacy and finally the resource cost [68].

Interviews can be classified in to three main types [69]: Structured interviews, unstructured interviews and semi-structured interviews. Structured interviews are used when the researcher has predetermined questions such as questionnaires, and asks the respondent (face-to-face) to offer limited option answers.

Unstructured interviews are used in the event where the researcher does not need a list of questions, and the researcher's role is to introduce a topics or themes and then allowing the interviewee to express their ideas and explore in depth about it. Generally, unstructured interviews aim to explore issues rather than prove their existence.

As for Semi-structured interviews, the interviewer still has an obvious list of questions to be answered and issues to be addressed. Answers will emphasise on the points of interest to the researcher; also they are an open-ended answers [70]. The purpose of semi-structured interviews is to identify themes, and then design a tool to subsequently test it at the next phase. In general, the researcher uses this approach when he or she does not know about the variables, instruments and measurements about the population of the study, which requires him or her to explore more about it [71]. Since this study is an exploratory research, semi-structure interviews are conducted in depth with general managers.

The data was collected by.

The research interviews were conducted by the researcher. Through semi-structured interviews, a set of carefully studied questions were presented to collect data. Interviews were held with the respondents in different locations, some were interviewed in their workplace and others in locations of the network towers during filed visits to the sites. Through face-to-face interviews, the researcher was able to create a complete picture of the subject matter, which helped the researcher better understand and reflect the situation through the respondent's tone of voice, his confidence and emotions, in addition to body language [72].

The second benefit of face-to-face interviews is the speed of obtaining information, so that there is no large time interval between the question and the answer, in addition to the possibility of expanding some questions to emanate from the main question other sub-questions to increase understanding [73].

Interview questionnaires were sent to the respondents before conducting the interviews to give them the opportunity to prepare for them freely and get an adequate impression of the nature of the interview questions [74]. The respondents agreed to the researcher's request to make an audio recording of the dialogue. The interviews were smooth and the researcher allowed the respondents to speak freely and fluently to give sufficient information.

The results of the interviews were recorded after hearing the audio recordings, and they were returned to the respondents to verify the validity

of the data. This gave the researcher an opportunity to get saturated with information and to delve deeper into the answers of the respondents, which helped the researcher to analyze the data in depth [75]. This enhances the reliability of the data collected through semi-structured interviews. Through these interviews, the researcher obtained a valuable amount of information that enriched the study [76].

3.7.3.1 Validity and Reliability

In this research, it was important to have access to a variety of data sources within the Palestinian mobile operators (Jawwal and Ooredoo). This approach triangulates the collected data, which greatly helps to validate the results. The use of data triangulation to collect data from several sources such as interviews, company documents, site visits, and observations corroborates and supports the validity of the results. The content of the interviews was investigated and validated by presenting the interviews to three distinguished academics with experience, three experts in the field of communications, and one engineering management expert (see Appendix C). They were asked to arbitrate the interview protocol standards, accuracy, precision, orientation, order, context, language, and time frame.

Table 3.1: Quality measures to enhance the reliability and validity of the data used in the Thesis

Internal validity	Improved by theoretical conceptualization of the research questions
Construct validity	Improved by using multiple sources of evidence: Interviews and documentary analysis, and observations or field visits
Content validity	Improved by examining the available literature
Reliability	Recording interviews and taking notes

3.7.3.2 Ethical Issues

The research was objective and devoid of negative biases that affect the results of the research. The researcher committed not to reveal the identities of the respondents at their request. The researcher assured them that the confidentiality and security of the information they share will be maintained, and the respondents were referred to by their job titles and the company they work with. The collected data will be used for scientific research purpose only. Furthermore, an official letter was sent from the university to all the parties that were interviewed.

3.7.3.3 Interview Design

A closed interview structure has been established by the researcher to answer from respondents by selecting from many options, or open-ended questions, where the respondents are free to answer and go deep in details and negotiations. The purpose of the interview is to collect qualitative data from experts in Palestinian mobile operators. The interview was designed

by reviewing the literature from academic papers and the other interviews that related to the study as a first draft, after that display it on experts and takes feedback [76]. The last revision from the questionnaire contains as following:

- First section: (16 items) the purpose of this section is to collect general information about the organization and interviewee such as the position of respondent, years of experience at organization, and contact number, as well as the name of organization, the number of employees, the geographic location, and main product and service.

- Second section: (7 items) it aims to assess the degree of the possibility to applied and adopted mobile network infrastructure sharing in Palestine. The section aims to get general information about the topic.

- Third Section: (10 items) this section studies the drivers and barriers that stand in the way of implementing mobile network infrastructure sharing in Palestine.

- Fourth Section: (7 items) this section studies the factors effecting the implementation of network infrastructure sharing among mobile operators.

After preparing the last draft of the interviews, they were revised by a group of experts in the field to judge the validity and reliability of the interviews. All comments related to the classifications of the sectors, addition of sentences or length of sentence, language and other modifications have been taken into account to improve the internal validity

of the interview. The final revision of the interview was prepared in English (see Appendix A), but since the mother language in Palestine is Arabic, we translated it to Arabic (see Appendix B).

3.8 Analysis Procedure

In order to understand and familiarize the practices of mobile network operators from the point of view the organizations of communication sector in Palestine, the researcher conducted twenty semi-structured interviews. The thematic analysis approach is used to analyse the data generated from the interviews conducted with mangers and experts in the communication sector. Thematic analysis is considered as one of the most popular research analytic approach methods in the world, as it has numerous features such as flexibility, easy method for learning, and useful in qualitative analyses approaches [75]. Thematic analysis is a method for recognizing and analysing patterns (themes) and finally reporting them within data [76]. This approach contains the following steps [75]; as following:

1. Knowing the data: recording the data, copying it, and reading it more than twice to grasp it.
2. Create codes: Data coding, focusing on interesting points, and then associating harmonious data with the same code.
3. Looking for themes: Arrange codes into suitable themes, gathering all data belong to each potential theme.
4. Reviewing themes: Check whether the themes are related to the codes formed in the first and second phases.

5. Naming themes: Consecutive and sequential analyses of all themes, and access to clear titles and definitions for each theme

6. Report design: The last stage of the analysis. A final definition of the results of the analysis by linking the conclusions with the objectives from which the research emerges.

In this stage, the researcher listened to recordings of interviews several times to get familiar with them, and to generate codes and then gather similar codes to find themes. Afterwards, the researcher reviewed the themes, and finally defined them.

3.9 Summary of Chapter

This chapter presents the methodology used in the preparation of this study. Additionally, this chapter presents the research design, the target population and the represented sample with justification of the choices. It also explains the tools used in conducting the research which was selected based on the relevant literature review and the validity and reliability of the measurements. Finally, this chapter presents the data collection procedures used for the selected qualitative approach.

Chapter Four

Data Analysis & Results

4.1 Chapter Overview

In this chapter, the researcher presents the findings of the data analysis generated using the qualitative approach. The qualitative analysis of the interviews was performed using the thematic analysis approach. This analysis will assist in reaching the results of the research. Furthermore, it is worth stressing here that in addition to the interviews, the researcher studied the reports of mobile operators on network performance, and conducted site visits to mobile site locations used by mobile operators in Palestine, such data helps in developing infrastructure sharing framework adapted from TOE framework.

4.2 Interview Analysis

The researcher adopted the exploratory research approach to get more information about the research questions and to develop more familiarity with the practices of mobile network operators in the communication sector. The initial step in a qualitative approach is conducting semi-structured interviews with experts working in the mobile communication sector [77]. Thus, twenty semi-structured interviews were conducted with experts from the two Palestinian mobile network operators Jawwal and Ooredoo, in addition to engineers who work in telecom contracting companies.

The interviews include four planning managers, six optimization managers, six deployment directors, two technical advisors and two experts from the telecom contracting sector. Table 4.1 below shows the names on the companies in which the interviewees work and their job titles.

Table 4.1 Targeted Organizations and List of Interviewees

No.	Sector	Organization	Job Position	Years of Experience
1	Telecommunication Company	Jawwal company	Planning Manager	11
2	Telecommunication Company	Jawwal company	Optimization Managers	15
3	Telecommunication Company	Jawwal company	Deployment Director	5
4	Telecommunication Company	Jawwal company	Technical Advisor	6
5	Telecommunication Company	Jawwal company	Senior Civil Engineer	7
6	Telecommunication Company	Jawwal company	Manager of Transmission	9
7	Telecommunication Company	Jawwal company	Head of Section at Radio Department	16
8	Telecommunication Company	Jawwal company	Senior at Planning Deployment	4
9	Telecommunication Company	Jawwal company	Head of Unit at the Administration Department	22
10	Telecommunication Company	Ooredoo company	Planning Manager	9
11	Telecommunication Company	Ooredoo company	Optimization Managers	8
12	Telecommunication Company	Ooredoo company	Deployment Director	12
13	Telecommunication Company	Ooredoo company	Manager of Transmission	6
14	Telecommunication Company	Ooredoo company	Planning Assistance	3
15	Telecommunication	Ooredoo company	Civil Engineer	8

	Company			
16	Telecommunication Company	Ooredoo company	Electrical Engineer	5
17	Telecommunication Company	Ooredoo company	Manager at Radio Department	14
18	Private Shareholding Company	Inter. Telecom. & Elect Corporation Company (ITEC)	Civil Engineer	13
19	Private Shareholding Company	Inter. Telecom. & Elect Corporation Company (ITEC)	Electrical Engineer	12
20	Private Shareholding Company	Mobile Telephony System Company (MTSC)	Civil Engineer	15

The researcher conducted interviews with the persons indicated in Table 4.1 above in oral and written form in order to answer the research questions and attain the desired goals of the study. During the interviews, specific questions were asked to interviewees about the general factors that prevent the implementation of mobile network infrastructure sharing in Palestine, factors that encourage mobile infrastructure sharing, and factors that may limit the phenomenon of overrun costs. Moreover, the interview questions included questions about the procedures that may be used to implement infrastructure sharing.

All interviews were recorded using a recording machine to analyse the interviews easily and avoid bias [77]. The interviews were analysed based on guidelines from thematic analysis approaches [78]. The main focus of the analysis was to find related themes of interesting features that reflect barriers and drivers of mobile infrastructure sharing, and to define the influence of TOE factors on adopting mobile infrastructure sharing.

4.2.1 Interview Design

The researcher designed the interviews in an organized manner that reflects the objectives of the research and answers the research questions. Each interview consists of five sections, under each of them falls a set of questions. The interview design is as the follows:

1. Interviewee's general information;

2. Company's general information;

3. General information about infrastructure sharing;

4. Infrastructure sharing drivers and barriers;

5. Factors influencing the adoption of infrastructure sharing among mobile operators.

4.2.2 Conducting Interviews

4.2.2.1 General Information

This section includes questions related to infrastructure implementation in general, and how operators encourage infrastructure sharing from the point of view of the interviewees. Also, it is related to how the Palestinian Ministry of Information Technology and Telecommunication deals with the implementation of infrastructure sharing. Furthermore, this section extensively looks into the importance of sharing the infrastructure of mobile operators in Palestine through seven well thought-out questions.

1. Researcher: What form of infrastructure sharing (active or passive) do you prefer most?

   o Active (e.g. switches/routers, radio equipment's, spectrum, antenna, BTS/BSC/RNC)

   o Passive (e.g. towers, power, air conditioners, ducts, security, equipment rooms, mast)

   o Both

   o None

   Responses: Fourteen respondents prefer passive sharing infrastructure sharing, which includes sharing passive elements of network only. The respondents explained their reasons for this choice: "This type of sharing is the easiest one"; "It is the first type that can be tested when starting to implement sharing strategies"; "This form prevents major interference of mobile network operator's components"; "There remains a kind of privacy in the network which allows competition to exist". On the other hand, six respondents prefer not to implement infrastructure sharing strategy because they find that they may lose the competitive advantage that enables them to distinguish themselves from others by owning some special sites.

2. Researcher: Do you support ICT infrastructure sharing in coordination with the Government? Why?

   Responses: the number of respondents who support ICT infrastructure sharing in coordination with the government where fifteen respondents.

Their reasons for such position are: coordination by government reduces bias and facilitates procedures, and government involvement makes the implementation of sharing easier. Procedures require time, so it is better to have a third party that is responsible for sharing practices. Also, from an organizational point of view, it is better to make decisions go through government, as governments make impanation mandatory. Respondents also pointed out that the government is a neutral party, this means that it will implement unified decisions that serve all mobile operators.

On the other hand, five respondents refuse the idea of having sharing of available sites implemented through the government, as they prefer sharing to be only through joint cooperation between mobile operators. Their reasons behind such opinion are: Coordination is better to be just between operators, so that they have the ability to negotiation; the implementation of infrastructure sharing is easier if it is only between operators, since they are familiar with network details. It is preferable to keep sharing between operators, they can handle sharing in a proper way, while taking into consideration their competitive advantages. Discussions related to infrastructure sharing must be referred to mobile operates as they can manage site sharing between each other, first operator gives other operator the opportunity to share certain sites in exchange for another site of equal importance.

3. Researcher: Should the Palestinian Ministry of Information Technology and Telecommunication make ICT infrastructure sharing voluntary or mandatory? Why?

    Responses: From the respondents' point of view, some believe that mobile infrastructure sharing cannot be implemented based on a decision from mobile operators themselves, but rather it should be imposed by the Ministry of Information Technology and Telecommunication. This was the opinion of thirteen respondents, while the opinion of remaining seven was that mobile infrastructure sharing should be voluntary, and through periodic meetings between mobile operators, without interference from any third party.

    Respondents who see that mobile infrastructure sharing should be mandatory had the following reasons: if infrastructure sharing is left to the decision of mobile network operators, then the task will be more difficult. Sharing will be without any kind of bias, there will be fewer discussions between mobile network operators, and the decision will be in the hands of the Ministry of Information Technology and Telecommunication. In case sharing is not mandatory, one operators will end up obtaining additional advantages over others. In the event that sharing is mandatory everyone will benefit, and there will be no loser. Mandatory means commitment.

    Respondents who see that mobile infrastructure sharing should be voluntary provided the following reasons: Voluntary sharing allows

mobile network operators to be free to choose and maintain their competitive advantage. There are many site locations that are owned by one of the operators, which gives that operator a competitive advantage over others and this is makes the choice critical. Having a matter as optional allows negotiations and better thinking for all parties.

4. Researcher: Should the government give incentives, such as tax and license fee concessions, to mobile network operators who share their infrastructure?

   Governments can make mobile infrastructure sharing more beneficial through the use of incentives, such as license fee and tax concession. Governments can attract operators to implement sharing by giving such advantages. All twenty respondents find that governments should make tax and license fee free of charge, since this advantage will reflect directly on operational cost.

5. Researcher: Operators with excess capacity should share their information with other ICT operators and the Palestinian Ministry of Information Technology and Telecommunication to enable them to make infrastructure sharing decisions?

   Mobile operators usually keep their site location maps confidential, as each site location has a specific purpose. Some sites are used to increase coverage (the geographic area within which a carrier provides service) and others to increase capacity (the amount of traffic that a network can handle at

any given time), all are based on carefully studied plans. Informing competitors of site locations information could potentially pose competitive risks. The researcher asked if there is a possibility to share site location information of mobile operators who have larger capacity, if sharing where implemented in Palestine. Five respondent only oppose sharing information with other operators. Fifteen respondent find sharing information is a need that will enable them to use sharing strategy in the best possible manner.

Respondents who support sharing mobile network information comment that the information related to site location planning will not be confidential or privet after mobile infrastructure sharing implementation. It is necessary to provide other operator with site location information to make them able to think with all possible sites that can be used to get benefit from sharing. Operators' network details will not be available for competitors, only site location information will be shared. In many cases, operators may announce new sites locations in which they plan to expand, so they can ask competitors if they have already existing sites in target area to use.

Respondents who oppose the sharing of mobile network information argue that network details are not required to be shown to competitors. It is essential to maintain competitive advantage in some site locations. The previous organizational procedures for site establishment required

a great deal of time and effort. It is not right to present unique site locations on a silver plate to competitors.

6. Researcher: Which infrastructure sharing business model do you prefer most? Why?

- o Self-Operator controlled
- o Third party controlled
- o Government controlled

In order to confirm the answer of question number two, the researcher presented the question in another way. The respondents were divided into three groups, the first group preferred that sharing should be made through organization between mobile services operators only, among themselves. The number of respondents with this opinion is five.

Another group of respondents preferred that sharing be implemented through a third party, such as having a neutral specialized company that organizes the matters of sharing from the beginning to the end, and the number of respondents with this opinion is ten respondents. As for the third group, which consists of five respondents, they see that sharing should be implemented through the government or the Palestinian Ministry of Information Technology and Telecommunication.

Respondents who prefer that sharing arrangement be controlled by the government justified their preference saying that sharing

through a governmental entity will be mandatory. Mobile network operators feel much better if sharing was implemented by the government, as responses to sharing will be faster, sharing decision will be fair and unbiased, and rules and strategies of sharing will be critical and clear. Furthermore, with governmental engagement, operators' commitment will be much stronger.

Respondents who prefer sharing arrangement to be controlled by a third party justified their selection saying that a third party is neutral and does not take sides. A third party may be more available to complete the sharing procedures than others. A third party can help operators choose the best options available for sharing. Operators can inform the third party of the network sites without hesitation to achieve the maximum benefit. When third party do the job of sharing time and effort will be saved. If passive sharing implemented through third party, then active sharing can also be studied to start implementation easier.

Respondent who prefer sharing arrangement to be self-operator controlled justified their chose by saying that the management of the sharing process must be performed through the related operators. Sharing may be implemented in some locations according to the agreement between the operators. It is possible for one operator to give the other a privileged position in exchange for another. Only operators themselves are most familiar with the sharing methodology, modality and requirements. Competitive

advantage features will be more controlled. Mobile network operator may have new department called sharing management department with special engineering how good experience have in network planning and optimization.

7. Researcher: From your point of view, is the infrastructure sharing decision mainly driven by an operator's desire to reduce capital and operational expenses so as to maximize on profit margins and remain competitive? How?

Financial and operational capital cost is one of the most important things that companies are trying to reduce by applying numerous practices. Palestinian telecommunication companies tried to apply several traditional procedures. The researcher asked whether the respondent believes that sharing the infrastructure of mobile networks would reduce the basic and operational costs needed to establish new sites such as (site wages, electricity costs, equipment costs, maintenance costs).

Eighteen participants said that the decision to share a network's infrastructure is influenced by the need for mobile operators to keep their capital and operating expenditures to a minimum in order to increase their profits. Two respondents said that reducing time and effort is the most important reason of sharing.

Respondents reported that sharing decisions are effected by an operator's need to reduce capital and operational expenses; operational

cost is the most important thing mobile operators should reduce. Cost reduction will reflect on the cost of the offered services.

Improving profit margin will cause operators to produce new offers for their subscribers. Once infrastructure sharing is implemented, operational cost will be shared and maintenance cost will be shared as well.

Respondents who reported that reducing time and effort is the most important reason of sharing argue that time will be reduced and negotiation efforts will be minimized.

8. Researcher: How can the operators' initiatives promote infrastructure sharing?

Mobile operators are the decision makers. Through their initiatives, they can support the implementation of mobile network infrastructure sharing in Palestine. As one of the most important goals that operators seek to achieve is providing the widest and fastest access to users and providing services of distinctive quality.

The researcher asks the respondents what are the first steps to start the process of sharing infrastructure for operators from their belief and how the idea can be implemented. Table 4.2 below presents the most important respondents' answers regarding first step in sharing strategies and   implementations:

Table 4.2: Steps in sharing and implementation strategies

Position of Respondent	First step in sharing, from respondents' point of view	Implementation, from respondents' point of view
Head of Section at Radio Department	Hold a meeting	Meeting should include all relevant parties such as mobile operators, ministry of communication, Palestinian electricity company
Senior-level Employee at Planning Department	Exploring new sits	Each operator have to provide other competitors plan of new site want to implement ,to study ways of cooperation
Head of Unit at Administration Department	Third party	Meeting with third party organization to discuss details of implementation
Optimization Managers	Ministry of Telecommunication and Information Technology	Start by setting the basic rules and controls for the implementation of network infrastructure sharing
Deployment Director	Hot site location	Solve the problems of critical and important sites by cooperating with competitors

4.2.2.2 Infrastructure sharing drivers and challenges

This section presents the questions related to infrastructure sharing drivers and challenges. According to literature review, previous studies concluded that the most effective driver of infrastructure sharing are cost optimization [79], facilitation of rapid deployment of mobile infrastructure for new operators and increasing coverage with better deployment cost [80]. New operators are more focused on sharing to minimize implementation and operational costs, as mobile network infrastructure deployment requires high capital investment, moreover, payback periods are long and might extend to over 8 years [81]. Through the following questions, the most important motives and obstacles that affect mobile infrastructure sharing in Palestine will be identified.

1. What does the company do in order to generate extra revenue?

Respondents: Usually, companies work to increase their profits through campaigns and offers made to their new and existing subscribers, especially to high frequency users, including university students. Moreover, companies offer additional revenue-generated services such as news, cultural, sports and other SMS services, and by following the policy of the guaranteed subscriber by allowing postpaid subscribers to purchase cellular mobile phones through invoices, thus ensuring their stay with the operator throughout the period of paying the price of the mobile phone. Additionally, mobile operators show more care of the environment by conducting workshops on radiation emitted from

communication towers and wave frequencies and not affecting humans and the environment, and awareness campaigns. Companies also provide community services that reflect a positive image of the community. They also constantly seek to provide good and high quality services to its clients and are committed to solving technical problems at a high speed so that we provide service everywhere and every time.

2. Does infrastructure sharing facilitate rapid deployment of mobile infrastructure for new operators with better cost of deployment, how?

There are two mobile operators in Palestine only; Jawwal and Ooredoo. The researcher asked if sharing will effect new entrants' performance, and how will this reality affect the performance of a new operator.

Respondents: New entrants to the market will be more fortunate than other operators. Through the deployed mobile networks, they will be able to deploy their own network much faster. In terms of site costs, they will be less expensive. In terms of planning, the operators that launched before them will help to predict the size of the network, the number of sites and the most important sites. One of the most important plans that operators are keen to work on is the study of the expected profits in the coming years, and for new operators it will be more predictable. New operators will wait for all that is positive and will work towards attaining their goals, especially with regard to infrastructure costs.

All twenty respondents agree that infrastructure sharing facilitates rapid deployment of mobile infrastructure for new operators with better cost of deployment.

They will benefit from the already existing infrastructure to implement their own site locations. This is the same opinion in literature, and has happened in many countries [82].

3. Will the implementation of infrastructure sharing enable operators to focus more on their core business and innovations? Explain?

The researcher asked the respondents if they think that infrastructure sharing in Palestine will allow operators to exert their best efforts in innovation and the creation of new ideas. Thus, when the sharing is applied, there will be a significant reduction in time and effort, thereby increasing the focus on other improvements to the network. Regarding this topic, respondents were divided into two groups, one consists of eighteen respondents who reported that infrastructure sharing results in more time for operators to focus on doing their best for the network's core business and development, while the remaining two respondents reported that sharing will not affect core business and innovation.

Respondents who believe that infrastructure sharing will give operators more time to focus on doing their best for the network's core business and development said that sharing network infrastructure will provide operators with more knowledge about the details of the competitors' networks and capabilities and this enables them to improve their old

weaknesses. Through implementing infrastructure sharing, there will be more time to think outside the box and control the operator's external and internal risks. The costs saved through infrastructure sharing can be exploited to innovate and fix network problems such as replacing outdated equipment.

4. How can infrastructure sharing affect coverage and network availability?

One of the most important things that mobile phone operators aim to attain is maintaining permanent coverage all the times and at all locations. Calls should not be interrupted, as every time the calls are cut off, surveys and studies are conducted to solve the problem and avoid it.

Respondents: When infrastructure sharing is implemented, network availability and coverage will be better, as it will enable operators to reach hard-to-reach site locations, such as accessing a competitor's owned site located on an external road between cities that requires permissions and complex political and administrative arrangements. Problems with poor network coverage will be resolved faster by sharing locations with other operators. By sharing the infrastructure, the coverage of new areas, especially those on the outskirts of cities, will be faster, as the infrastructure and operational expenses will be divided among the operators and the effort as well. Some of the existing sites need to be moved sometimes due to the change in the surrounding conditions, such as the construction of a residential building opposite the site, a reflective wall that affects the signal arrival, or any circumstance

that requires moving the site, this problem can be solved by sharing with another operator so that there are no problems to cover in a short time.

5. What are the drivers of infrastructure sharing?

The researcher asked the respondents about the motives of infrastructure sharing implementation in Palestine. Through previous studies, it is found that there are many benefits and interests that network operators obtain through sharing.

Responses: Sharing helps reduce operators' costs of deploying the mobile network. Sharing facilitates the rapid deployment of mobile infrastructure for new operators with better cost of deployment, and the optimal use of network elements. Furthermore, it gives operators more time to focus on doing their best to improve their network's core business and develop it. Infrastructure sharing also improves our environment due to the reduction of electronic waste, and increases coverage and access to mobile operators' services. Infrastructure sharing improves network reliability and promotes cooperation between different competitors.

6. Can infrastructure sharing lead to efficient utilization of scarce resources?

By studying previous literature, operators aim to preserve scarce resources through infrastructure sharing. The researcher asked participant whether mobile network operators in Palestine think that infrastructure sharing would preserve scarce resources such, as electricity and fuel.

Respondents' answers were split between those supporting the idea and those opposing it; seventeen respondents said that they believe that infrastructure sharing preserves scarce resources, and only three participants had an opposite opinion. Supporting respondents say that infrastructure sharing preserves scarce resources such as fuel. The concerns for resources reflects positively on the sustainability of institutions, and sharing positively affects the preservation of scarce resources such as electricity. With scarce materials conservation practices, network infrastructure sharing is the first step.

On the other hand, opposing respondents claim that sharing will not limit the use of scarce resources. Each operator will consume the same amount of resources whether there is sharing or not.

7. What are the barriers of infrastructure sharing in your company?

The researcher explores the obstacles that stand in the face of mobile operators preventing them from implementing infrastructure sharing. The researcher asked this question directly to respondents. Through the interview, feelings of fear, anxiety and resentment were evident on the faces of the respondents. The answers varied and they described the situation very accurately.

Respondents: The lack of serious decisions by regulators in imposing the implementation of infrastructure sharing. The fear of losing competitive advantage of each operator, like important site locations and other network details. Lack of regulatory framework. Fear and anxiety of

intellectual property theft of each mobile operator. Mobile operators have different vendors and equipment which may affect implantation, for example, the size and weight of the antenna and transmission equipment will be different so the durability of monopole will not be evenly distributed among the operators and the increase in network traffic may require to adding more equipment. Moreover, there is a lack of regulatory capacity. The dispute over defining the participatory process organizer responsible for defining strategies and following up on the implementation of infrastructure sharing. There are many possible options, each with its own pros and cons. The competing networks may not be compatible and shareable. The infrastructure of mobile networks is in need of periodic maintenance and upgrade. If there is sharing, it will be difficult to determine who is responsible for maintenance procedures and costs and methods of infrastructure development. Multiple taxes imposed by the government on mobile operators are a huge burden and can be a barrier towards implementing infrastructure sharing. Lack of supporting infrastructure. The complexity of management to study the idea of sharing infrastructure and form strategic plans to research how to implement sharing. Lack of long term vision. Sharing cannot implemented without top management support. There must be a clear mechanism for settling disputes.

8. How Sharing exposes operator to risks?

The researcher asks how mobile infrastructure sharing can expose operators to risks, including both internal risks, external risks, and technology related risks. Respondents' opinions revolved around three main axis, which are:

- The environmental context: Care and attention to retain and increase the market share of operator.The economic movement greatly affects the performance of network users, as it affects the purchasing power of the consumer and profits as they operate mobile phones. Absence or weak legal framework and policy.

- The technological context: the high costs associated with network infrastructure upgrades and network development. The intense competition and users' continued need for new products in the world of communications technology.

- The organizational context: At the level of the organization, there is the fear of the risk of adventure and the experience of engaging in infrastructure sharing for the first time in Palestine and possibility of the failure to achieve the required results in terms of reducing time, effort, and capital and operational expenses.

9. How do regulatory and policy frameworks guide operators towards infrastructure sharing?

The regulatory and policy framework guides operators towards infrastructure sharing by obligating operators to implement infrastructure sharing, providing future plans and studies regarding infrastructure sharing, exempting operators who adopt infrastructure sharing from some taxes as an incentive, facilitating legal procedures for the establishment of new sites, and setting fair policies for settling disputes arising in connection with the implementation of infrastructure sharing.

10. How can your company enhance its market share?

Innovation is one method by which a company may increase its market share. When a firm introduces a new technology to the market, its competitors have yet to offer these services. Moreover, market share can also be improved by strengthening customer relationships, which also helps companies protect their existing market share by preventing current customers from leaving them when a competitor launches a new offer.

4.2.2.3 Factors affecting the implementation of infrastructure sharing

In this section, the researcher focuses on studying the factors that affect the idea of sharing infrastructure for mobile operators in Palestine by studying the technological, organizational and environmental factors, with the aim of forming a conceptual framework that shows the impact of all factors on the decision to share.

1. How does the encouragement of mobile operators' managers affect the implementation of infrastructure sharing?

   Senior management support is the basis for starting the implementation of infrastructure sharing. Administrative decisions are what determine the first steps to start the process of sharing through organizational plans. The upper management can form a specialized committee to look into the implementation of sharing. Top level management can propose plan developed with stakeholders for communication ministry.

2. How can your company support its objectives through infrastructure sharing?

   The company can support its goals by improving the level of coverage. The more users, the higher the profits. Improving the work environment through better distribution of tasks. Sometimes companies resort to reducing the number of employees to avoid additional costs and this disappears if infrastructure sharing is applied between operators. Moreover, sharing helps in preserving the environment by reducing electronic waste and fuel emissions required to operate infrastructure equipment. It also increases the market share, and allows for more focus on innovation and providing new services.

   Additional benefits of infrastructure sharing includes reducing the time required to operate new sites, reducing the effort required to obtain permissions, and reducing the need to get into difficult negotiations with some of the site lessors, as in some cases the telecommunications

companies are exposed to great reluctance from the community towards establishing a new site in a specific area.

3. How do technology changes influence mobile network infrastructure sharing adoption in your company?

After the launch of 3G technology in 2001, operators started searching for the best methods of using network infrastructure, as the sharing of mobile network infrastructure started in European [22].The researcher asked the respondents whether technological development has an impact on infrastructure sharing, as the fourth generation service for cellular networks "4G" will be available in Palestine during 2022.

Responses: Respondents said that technological development is one of the most important motives for implementing infrastructure sharing. The launch of fourth generation services invites operators to participate in order to take advantage of all competitors' sites. The sharing of the infrastructure in itself is a feature of the procession of technological development. It is necessary to take advantage of modern antenna designs (triple antennas), which support the second, third and fourth generations.

4. How does your company's economic performance effect its decision to implement cost saving strategies such infrastructure sharing?

The researcher asked the respondents about how they think the economic situation in their country is reflected on the mobile network

operators' will to implement methods that save costs in order to harmonize with the status quo through sharing mobile network infrastructure.

Responses: The decline in the economic situation leads to a significant decline in an operator's profit. During the Covid-19 pandemic, profits declined by a large percentage and the financial situation of mobile companies was bad. It is necessary for operators to adopt sharing policies to avoid any emergency economic change. Infrastructure sharing reduces operational and maintenance costs, thus reducing costs and increasing profits. Therefore, mobile operators have an alternative plan to shield against sudden changes in the economic situation.

5. Does adoption of a legal framework and policies for infrastructure sharing lead to higher adoption of infrastructure sharing? Why?

Through the review of the previous literature, the researcher concluded that the first step towards implementing infrastructure sharing is establishing a legal framework that controls matters and sets limits for the implementation of sharing. Mobile operators aspire to have a political and legal framework to implement infrastructure sharing. By having specific legal framework disputes are reduced, as a legal framework eliminates doubts between operators. It establishes controls for implementing infrastructure sharing. Appropriate policies can encourage infrastructure sharing. Legal framework and policy from

which all activities and tasks can be defined. They are more useful if they are designed proactively, not just for short-term regulation only.

6. How do you respond to customers' demands for new ICT product/service (e.g. 3G/4G, money transfer)? Does this affect the adoption of infrastructure sharing?

In another way, the researcher asks about the impact of the development of technology on the application of infrastructure sharing. As technology is constantly evolving and the services provided by operators are evolving. Also, in addition to the increase in the number of subscribers.

The respondents were divided on this issue; twelve of them indicated that the increasing demand for modern technology supports the idea of implementing infrastructure sharing and directs us towards it. The other eight said that users' demand for modern technology does not affect the application of infrastructure sharing.

Responses: Our keeping pace with technological development in Palestine is very limited and requires a lot of political measures. At the present time, mobile services operators we are preparing to launch fourth generation services, which require high budgets that can be provided through infrastructure sharing.

4.3 Thematic Analysis

All interviews with respondents were recorded using a recording machine to analyse the interviews easily and avoid bias [77]. The interviews are analysed based on guidelines from thematic analysis approaches by [78]. The main focus is to find themes of related features that reflect the barriers and drivers of mobile network infrastructure sharing implementation in Palestine. Moreover, the research identifies three aspects that describe the organizational components that affect the firm's decisions related to the adoption of infrastructure sharing, which are Technology, Organization, and Environment, i.e. the (TOE) framework.

Table 4.3 Codes and themes in interviews.

Codes	Topics Discussed	Themes
Environmental Issues	Reduce electronic waste	Environmental practices
Practice	Supporting environmental practice	
Government	Mandatory sharing	Governmental practice
Third Party	Sharing with coordination with government	
Tax	Tax and license fee concessions by government	
Competitive Risk	Sharing site location information with competitors	
Quality	Quality of service	Competitive advantage
Market Share	Enabling new entrant to launch market rapidly	
Cost	Reduce operational expenses	
Profit	Reducing capital expenses	Economic performance
Financial	Maximize profit	
Core Business	Use sharing to focus on core business innovations	Operators innovations
Quality	Network availability	Network coverage
Location	Solving site location	

	problems	
Implementation	Steps to implement mobile infrastructure sharing	Operator Initiatives
Rules	Rules of sharing	
Site Locations	Art with important site	
Profits	Sharing increase profits	
Quality	Network improvement	Motivation
Planning	Site location creation speed	
Negotiation	Contract	Legal procedures
Laws		Regulatory policy
Responsibilities	Infrastructure requirements	Maintenance and upgrading
Problems		

As a result, ten themes were found after analysing all semi-structured interviews, which are as follows:

4.3.1 Theme One: Environmental Practices.

The theme of environmental practices helps the researcher in identifying how mobile infrastructure sharing will contribute to preserving the environment. Most respondents mentioned that the implementation of mobile infrastructure sharing will reduce electronic waste. It reduces energy consumption, which contributes to preserving the environment. Moreover, it contributes to the preservation of the urban landscape of the environment by reducing the number of sites and arranging them in a better way so that one site contains communication cells for more than one operator.

Respondents also explained the environmental practices that are already applied by mobile operators company. Their companies apply some green practices such as the use of electronic systems instead of paper, the use of

clean energy, the use of solar cells and the use of specific systems that help in reducing energy consumption.

4.3.2 Theme Two: Governmental Practices.

The governmental practices theme helps the researcher identify how mobile infrastructure sharing will be implemented in coordination with the governmental authorities. Most of the respondents mentioned that infrastructure sharing in coordination with the government or third party will be better than self-controlled, as coordination by the government reduces bias, facilitates procedures, and makes the implementation of infrastructure sharing easier. Also, the implementation of infrastructure sharing through the government make procedures faster, and will make the implementation mandatory.

In addition, governments can encourage mobile network operators to implement infrastructure sharing by exempting them from taxes and providing legal facilitation for new site creation procedures.

4.3.3 Theme three: Competitive Advantage.

In this theme, most interviewees affirmed the importance of maintaining a competitive advantages that distinguishes them from their competitors, such as information about the distribution of network sites and related information. Respondents suggested to share information only about new sites which they are planning to have. Moreover, respondents emphasized the need for exchanging privileged sites between operators (one very

important site versus another), to ensure gaining new competitive advantage.

4.3.4 Theme four: Economic Performance.

In terms of economic performance, it is important to mention that the main objective of sharing mobile infrastructure from the respondents' point of view is to reduce capital expenditures (CAPEX) and operational expenses (OPEX), thus increase profits. Also, the respondents mentioned that infrastructure sharing can be a tool useful in difficult economic situations where there is a decline in revenues.

Respondents also explained that infrastructure sharing has multiple benefits that serve to achieve economic interests in an indirect way, such as efforts made to obtain permits and legal procedures, especially if the government allows tax exemption.

4.3.5 Theme Five: Operators Innovations.

Most respondents confirmed that infrastructure sharing helps operators focus more on doing their best for their network's core business and development, by saving time and effort associated with the procedures of establishing and operating a new site. Also, infrastructure sharing reduces operators' expenses, allowing them to invest those returns to improve network performance and focus on improving the quality of services in addition to new innovations

4.3.6 Theme Six: Network Coverage.

Through the interviews, the respondents stressed the need to improve the network's performance by reaching far areas (which are the areas in which operators need to have of towers but are unable to as there are many obstacles). Such areas cannot be reached so far because of political measures such as the occupation's refusal to allow the operator to establish a new site or community measures such as the residents' rejection to build towers on the rooftops of their houses, while allowing it for the other operator. Thus, respondents were sure that infrastructure sharing will make the procedure faster and easier, as the infrastructure and operational expenses will be divided among the operators.

On the other hand, in the interviews, the respondents were also supportive of the opinion that sharing solves the coverage issue in crowded places where changes occur in the nature of the environment surrounding the tower by moving the site from one place to another.

4.3.7 Theme Seven: Operator Initiatives.

According to the opinions of all interviewees, mobile operators are decision makers; they can start implantation of mobile infrastructure sharing through a set of steps. These steps, as specified by the interviewees, are presented in Table 4.4 below.

Table 4.4 Operators' initiatives to implement infrastructure sharing

No	Steps	Details
1	Identify all stakeholders	− Mobile network operators − Ministry of Telecommunication and Information Technology − Contractor and others
2	Hold kickoff meeting	− Meeting with all stakeholders
3	Define project scope	− Methodology, strategic plan, decide who will lead sharing implementation
4	Set project goals	− Exploring new sites
5	Third party	− third party organization to discuss details of implementation, and discuss hot site locations
6	Ministry of Telecommunication and Information Technology	− setting the basic rules and controls for the implementation of network infrastructure sharing
7	Risk management plan	− Make a plan to assess potential risks − Create a plan to resolve conflicts and disagreements

4.3.8 Theme Eight: Motivation.

The interviewees stated that there are many motives for mobile network operators to implement infrastructure sharing. In terms of savings, infrastructure sharing plays a great role in reducing the costs that are required to implement, operate, manage and maintain sites. This is reflected on the company's performance as a whole through its ability to adopt new creative ideas, improve the network and provide incentives for the company's employees.

The respondents shared the opinion that through the implementation of infrastructure sharing, the network performance will improve, which will allow for the filling of gaps caused by some suspended sites, in addition to allocating more time and effort for the completion of the creation of a new site. Infrastructure sharing helps new operators to launch their services more rapidly, and allows for efficient utilization of scarce mobile operators resources. It enables operators to focus on doing their best for the network's core business and development, and improving the environment by reducing electronic waste connected to network expansion. Infrastructure sharing will also help operators get rid of the hurdles associated with obtaining clearance from multiple government agencies for the creation of new sites.

4.3.9 Theme Nine: Legal Procedures and Regulatory Policies.

Regarding the need for regulatory and policy framework for the implementation of infrastructure sharing, respondents see that operators need regulatory and policy framework to lead and guide operators towards infrastructure sharing, by obligating operators to implement infrastructure sharing, providing future plans and studies, exempting operators from taxes imposed on them as a kind of incentive, facilitating legal procedures for the establishment of new sites, and setting fair policies for settling disputes.

4.3.10 Theme Ten: Maintenance and Upgrade.

Most respondents share the opinion that maintenance and network development procedures should be dependent on a third party who shall be responsible for regulating and implementing infrastructure sharing. The logic behind such opinion is that it prevents one of the operators from evading responsibility, in addition to distributing the periodic costs associated with the infrastructure maintenance among all participating parties.

4.4 Objectives

4.4.1 Objective 1: Barriers of infrastructure sharing among the two Palestinian Mobile Network Operators; Jawwal and Ooredoo.

4.4.1.1 Competition Issues

The two existing operators tend to be cautious in implementing mobile infrastructure sharing for several reasons, including the issue of competition. Through previous studies on other operators from all around the world, the researcher found that the operators were the main reason for their reluctance to implement infrastructure sharing at an early date, which is the fear of losing the competitive advantage.

In 2020, the Palestinian Ministry of Telecommunication and Information Technology unified the cellular communications tariffs for the current operators in Palestine. This caused the competition to be more focused on

the quality of services provided by each operator. Through the interviews, the researcher found that what distinguishes one operator from the other is the quality of its services and its ability to solve the problem of weak and unstable coverage. Through sharing infrastructure, as agreed by the respondents, it is possible to lose a large part of this advantage, making competition more difficult and complex.

One of the interviewees suggested that sharing be only for new sites, so that the operator submits a request to establish a new site in a specific area to the party responsible for sharing implementing, whether it is the government or a third party. The request is studied and implemented, if possible, according to laws and regulations set by the Palestinian Ministry of Telecommunication and Information Technology. From the study, it was pointed out that mobile network operators should enter into cooperation to implement infrastructure sharing for the benefit of all competitors.

4.4.1.2 Regulatory & Policy Framework:

The legal and policy framework guides operators taking part in infrastructure sharing by enacting proper laws and conditions for implementing infrastructure sharing [22]. The literature illustrates that the absence of legal framework forms a strong barrier for infrastructure sharing. Through this researcher, it was found that the operators in Palestine suffer from the absence of a law that clarifies the policies of the sharing of the infrastructure of the Palestinian telecommunications sector, and this constitutes a major obstacle towards starting to implement the

sharing. Respondents stressed the need for a legal framework that clarifies the mechanism of sharing, its laws, and the penal code in the event of non-compliance with this framework.

4.4.1.3 Maintenance and Upgrade:

Mobile network infrastructure needs periodic maintenance and update [18]. Through this research, it is evident that there are different opinions on this issue, some respondents decided that maintenance and updates on the parts of the infrastructure that were shared is a joint responsibility that is shared among the operators, while others think that each operator is responsible for maintaining and updating the part related to the components of its infrastructure. The multiplicity of opinions regarding this issue constitutes an obstacle towards the direction of infrastructure sharing, as it is necessary to have a clear law regulating this issue.

4.4.1.4 Taxes:

Multiple taxes imposed by the government on mobile operators pose a significant burden and can present a barrier to implementing infrastructure sharing. While reviewing the previous literature in the field of study, it was found that many regulatory policies support mobile operators to implement mobile infrastructure sharing through the responsible authorities exempting operators from taxes. Through the interviews, the respondents shared of the opinion that the Palestinian Ministry of Telecommunication and

Information Technology should provide solutions to the tax problem to help implement infrastructure sharing.

4.4.1.5 Top Management Support:

Literature illustrates that the support of senior management is one of the most important pillars for the successful implementation of infrastructure sharing [83], as they are the decision makers and the first initiators. Through the research, it was found that the senior management tends not to support the idea of sharing infrastructure and even avoid discussing this issue, which led to the respondents' dissatisfaction, as the respondents explained that the idea of infrastructure sharing was proposed, but without any real orientation and without any serious action taken towards starting sharing.

4.4.2 Objective 2: Drivers of infrastructure sharing among mobile operators in Palestine

Through looking into the experiences in many different countries around the world, it is found that the application of infrastructure sharing for the telecommunications sector falls under many benefits at the economic, environmental and social levels, as well as at the level of the organization.

Through the interviews, it became clear to the researcher many motives for implementing the infrastructure sharing. Table 4.5 provides a listing of the most important motives for implementing infrastructure sharing.

Table 4.5 Important motives for implementing infrastructure sharing.

No	Infrastructure Sharing Motives	Description
1	CAPEX and OPEX	Decrease capital and operational expenditures, which generates extra profit for mobile operators.
2	New entrants	Enables new operators to spread network services faster without going through difficult logistic procedures.
3	Scarce resource	Efficient utilization of the scarce resources of mobile network operators.
4	Innovation	Enables mobile operators to create and work more to improve their core business
5	Environmental issue	Improves environmental practices due to reduced electronic waste.
6	Increasing coverage	Improve mobile network coverage with solving coverage hols

4.4.3 Objective 3: Assess the readiness level of mobile network operators to adopt the proposed TOE framework for sharing available sites of Jawwal and Ooredoo companies
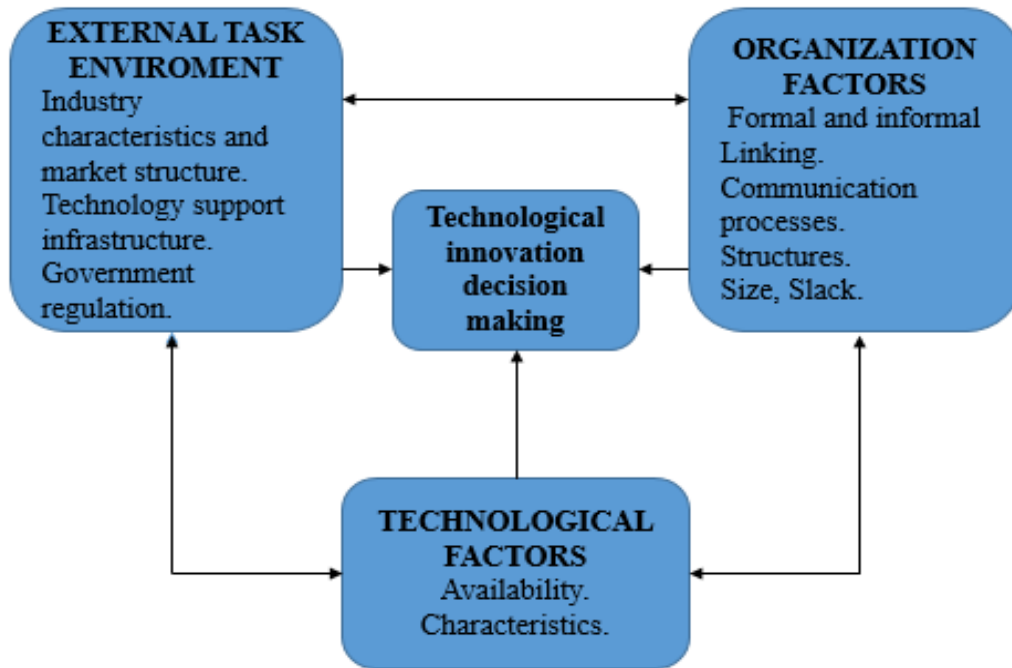
Figure 4.1 TOE framework (Tornatzky and Fleischer 1990)

The framework includes the three contexts of technology, regulation and environment, with factors influencing each one of them. The research adopted a total of nine structures (three for each context). The technological context deals with external and internal technologies that affect sharing, while the organizational context is defined by organizational commitments, strategic plans, and decisions made by departments to develop the organization and implement infrastructure s. As for the environmental context, it reflects the external framework surrounding the organization of competition and interaction with governmental laws.

4.4.3.1 Technological Context

The results of the study reveal that technological changes affect the adoption of mobile infrastructure sharing between operators, and most respondents were supportive of the opinion stating that the technological

development within the organization helps in implementing infrastructure sharing more effectively. Also, the entry of new technology requires more effective ways to conserve resources and increase profits, and this is done through the sharing of mobile communications infrastructure. Within the upcoming year, the 4G mobile service will be launched in the Palstinian market, and it is better if the infrastructure sharing starts from this stage.

Respondents explained that the competitive advantage can be enriched and strengthened by focusing on the quality of services that operators can provide through the adoption of modern technology in the network structure and setup, especially after unifying the price of mobile services tariffs in Palestine during 2020. One of the things that operators must take into account when implementing sharing is that some operators will lose an important competitive advantage when sharing sensitive sites with their competitors.

Through the analysis of the interviews, the researcher was able to specify many points that operators must take into consideration during the planning stage of the implementation of infrastructure sharing, including ensuring the compatibility of the existing technology with the possibility of integrating two or more operators in one site.

4.4.3.2 Organizational Context

Top Management Support

Through the study at the level of the organization, it is found that the important decisions are under the supervision of the higher management. Where the respondents unanimously agreed on the lack of this support from their departments, which constitutes a major barrier towards the implementation of infrastructure sharing. Senior management is like the captain who drives the ship. Managers must change their mindset and free themselves from anxiety and fear that impede them from implementing the idea of infrastructure sharing.

New market entrants

Through research, it is found that the new entrants to the telecom market will receive facilitations in all areas related to infrastructure equipment, as their first lines will be clear. Network size prediction will be easier for new entrants than it was for the previous competitors. In addition to saving the effort and time needed by the newcomer to deploy the network in the market. Most of the burden will be material, so that it will be mitigated by entering the market after applying the partnership.

Operator's Strategy

All respondents' opinions confirm the importance of including mobile infrastructure sharing within their organizations' strategic plans that are currently under development. Strategic plans are in the form of a set of

actions through which institutions achieve their goals. One of the most important elements of strategic plans is the resources that exist in organizations, as they always strive to preserve them. Managers should make greater efforts to make sharing feasible after creating a well-defined strategic plan.

Financial Resources

Operators seek to preserve financial resources. By analyzing the opinions of department managers at mobile network operators, it became evident that through sharing, the financial position of the operator can improve significantly, as the financial burden will be distributed to more than one operator, which allows the institution to act with greater financial freedom.

4.4.3.3 Environmental Context

The external environmental factors that affect the adoption of infrastructure sharing are based on the order of priorities, which are the low economic performance, the existence of legal and political frameworks, intense competition, and customer demand for modern technological services.

Economic Performance

The economic situation affects the implementation of infrastructure sharing. The decline in the economic situation is an incentive directed by the operators towards the implementation of infrastructure sharing in order to reduce the cost associated with establishing sites and reduce the operational costs that are spent on operating sites, and in turn, this is

reflected on improving profits or equivalence of the difficult economic situation.

Stiff Competition

It was found through the research that competition is clear in Palestine, as the number of mobile phone operators is limited (Jawwal and Ooredoo). The competitive advantage lies in the overall experience and the quality of services. Through the implementation of infrastructure sharing, competition will be more intense between the operators, and this will immensely shift the focus on improving the quality of the offered services.

Legal & Regulatory Framework

Mobile operators consider having a legal and policy framework to implement mobile infrastructure sharing processes as a necessity. Through a review of the previous literature, the first step towards implementing infrastructure sharing is to establish a legal framework that controls implementation and sets the limits of sharing. A legal framework defines the broad lines for the application of infrastructure sharing, its laws, and the laws for resolving disputes between the sharing parties.

Customer Demands

The users' demand for advanced telecommunication services increasing rapidly. From the answers of the interviewees, it is evident that the main aim of expanding a network is to meet the needs of users, especially towards new technology and basic communication services.

4.4.4 Objective 4: Define benefits of infrastructure sharing with special focus on cost reduction

No	Cost reduction levels
1	Reduce rent expenses
2	Reduce site setup expenses
3	Distribution of the cost related to road construction licenses needed for external sites
4	Distribution of the cost related to road construction licenses needed for external sites
5	Electricity subscription licenses and electricity meters
6	Taxes imposed by the government on mobile operators
7	Reduce maintenance costs and site development costs
8	Legal process cost

4.5 Summary and Discussion

Mobile infrastructure sharing is a strategy through which the available network resources are employed in an optimal way. By sharing network resources, operators share the core and operational costs of the network infrastructure. After the introduction of modern technologies for mobile communication networks, mobile operators have to move towards implementing infrastructure sharing to achieve optimal use of mobile infrastructure and improve network performance. Due to the intense competition between mobile operators and the high value of capital expenditures and the operating expenses of the mobile infrastructure, the

operators started to search for new and practical ways to improve the financial and operational performance of mobile networks in Palestine.

According to the research results, the implementation of infrastructure sharing between mobile network operators in Palestine is one of the best strategies that will help in achieving such fast gains by allowing competition through cooperation between mobile operators.

In Palestine, until the time of this research, there is no implementation of the infrastructure sharing strategies between mobile operators, while there is an increasing demand for mobile communication services in addition to the urgent need for the implementation of infrastructure sharing in order to address network issues and to contribute to economic growth. The research findings show zero level of sharing among mobile operators in Palestine, unlike other countries such as such as India and the USA. However, operators in Palestine can achieve high levels of infrastructure sharing can be achieved if operators cooperate with each other as business partners aiming to reap more benefit from sharing their infrastructure.

The interviews conducted as part of this research show overwhelming support to the implementation of infrastructure sharing based on the proposed TOE framework. The support of a mobile network infrastructure sharing decision is mainly driven by the operators' desire to reduce CAPEX and OPEX, which will enable them to maintain their competitive advantages.

Also, the advent of modern technologies such as 4G, made mobile operators search for the best ways to provide network infrastructure. Infrastructure sharing was one of the best strategies applied around the world to facilitate the rapid spread of the network and increase its efficiency. The Palestinian government must contribute to the implementation of infrastructure sharing in order to achieve economic and social gains. In order to provide a nurturing and proper infrastructure sharing environment, there is a need for an enabling regulatory framework that is controlled and supervised by the Palestinian Ministry of Telecommunication and Information Technology and supported by the stakeholders in the mobile communication sector. Mobile operators should seek to engage in the design of a legal framework with the Palestinian Ministry of Communications. As the implementation of infrastructure sharing rolls out, the next stage might include giving incentives to operators to encourage them to take role in sharing. For example, the Ministry of Telecommunication and Information Technology might decide to exempt these operators from the exorbitant taxes imposed on them. Furthermore, the competent government body must legislate clear laws related to the implementation of sharing, which can include making participation mandatory to ensure the commitment of all network sites without bias.

There is an increasing need for a regulatory framework that governs the implementation of infrastructure sharing in Palestine. Currently, in the Palestinian mobile operators, infrastructure development is left to the sole

decision of each operator and there is a lack of information about available excess capacity held by operators, which results in continuous network duplication and underutilization of valuable resources.

Based on the literature review and current situation in the Palestinian communication sector, and after analyzing the data collected through the qualitative approach, it is evident that there are some variables affecting the implementation of infrastructure sharing practices among Palestinian mobile network operators. The results are presented as follows:

- The research proves that the level of infrastructure sharing in Palestine between mobile phone operators (Jawwal and Ooredoo) is null (zero), and that no prior studies were conducted on this issue in Palestine, neither by the operators nor the Ministry of Telecommunication and Information Technology.

- The main five drivers of infrastructure sharing in Palestine are: the desire of new mobile operators to rapidly deploy their network, improve capital and operational costs in addition to increasing the rate of return on investment, preserve the environment, as well as the mobile operators' intention to develop network performance and improve the level of services by giving more focus, time and resources to improve the core business of mobile networks.

- The main five challenges of infrastructure sharing in Palestine are: the lack of a regulatory and legal framework to regulate the process of mobile infrastructure sharing, the fear of potential risks of sharing, such

as losing the competitive advantages connected to some privileged network sites, the lack of support and encouragement from decision makers and senior management in mobile operator companies, the high cost related to upgrading some sites so that they are able to handle the sharing of other operators' infrastructure, and the operators' keenness not to lose market share.

- The research demonstrates that the mobile infrastructure sharing TOE framework can be adopted to implement infrastructure sharing within an organizational context, which will have a greater impact than technology and external factors. Among the nine framework architectures tested, those with the highest impact were found to have lower capital and operational costs and higher level management support.

- The research also concludes that passive infrastructure sharing is the most preferred sharing type, while the preferred business model is the sharing of new towers and locations.

- Regarding initiatives, the research findings indicate that the Palestinian Ministry of Telecommunication and Information Technology should take the initiative to invest in the basic infrastructure, and seek to implement the sharing of telecom sector infrastructure, whether by making sharing optional or mandatory and imposing a legal framework to guide stakeholders.

- As for the parties most benefiting from the implementation of infrastructure sharing, the research results indicate that among operators, regulators, customers, the government and the population, both the customers and operators are the main beneficiaries from infrastructure sharing.

From the results of the search for mobile operators in Palestine, mobile operators (Jawwal& Ooredoo) prefer to start sharing the passive infrastructure due to its ease of application and the possibility of achieving the desired benefits through it. It was found through this study that there are many obstacles that stand in the way of the decision to share infrastructure and many motives that encourage the adoption of this strategy.

4.6 Discussion of TOE framework research findings

In comparison with other studies that adopted the same TOE framework, the Lippert & Chittibabu, 2006 study on the sharing of infrastructure to connect communication services through studying the impact of organizational, environmental and technological factors indicates that sharing contributes to increasing the return on investment and reducing operational costs, and this was similar to what our study found [81]. By implementing infrastructure sharing, operators will be able to get faster returns on their investments as a result of the reduced payback time and revenue gained from leased resources.

Boon & Zo 2014 used the TOE framework to study the factors that affect the sharing of e-governance infrastructure in developing countries and

indicated that support for senior management, the regulatory environment, competition and the development of information technology are prerequisites for sharing [82]. In our research, the presence of high support from senior management in organizations was one of the most important factors that influence the decision to adopt infrastructure sharing. The Shani 2017, study aimed to explore the important factors for companies to adopt broadband telephone sharing [83]. The results of the study were to enhance competitiveness by studying the three factors: environment, technology and organizational, and one of the most important factors affecting the adoption of sharing is the existence of regulatory laws to manage the application of sharing. In this research, the adoption of the TOE framework was a valid means to study the factors that affect the adoption of infrastructure sharing in Palestine. Whereas, through the interviews, the respondents focused on the necessity of having a political and organizational framework to implement sharing, in addition to the need for great support from the senior management. As for technological development, the respondents shared the opinion that it has less influence on the adoption of sharing strategy. An operator's decision to implement passive infrastructure sharing is mainly driven by the environment (external / internal) in which it operates. Upon the implementation of infrastructure sharing, operators will faces some challenges that must be overcome to guarantee that stakeholders get full advantage of the available opportunities and are able to benefit from infrastructure sharing.

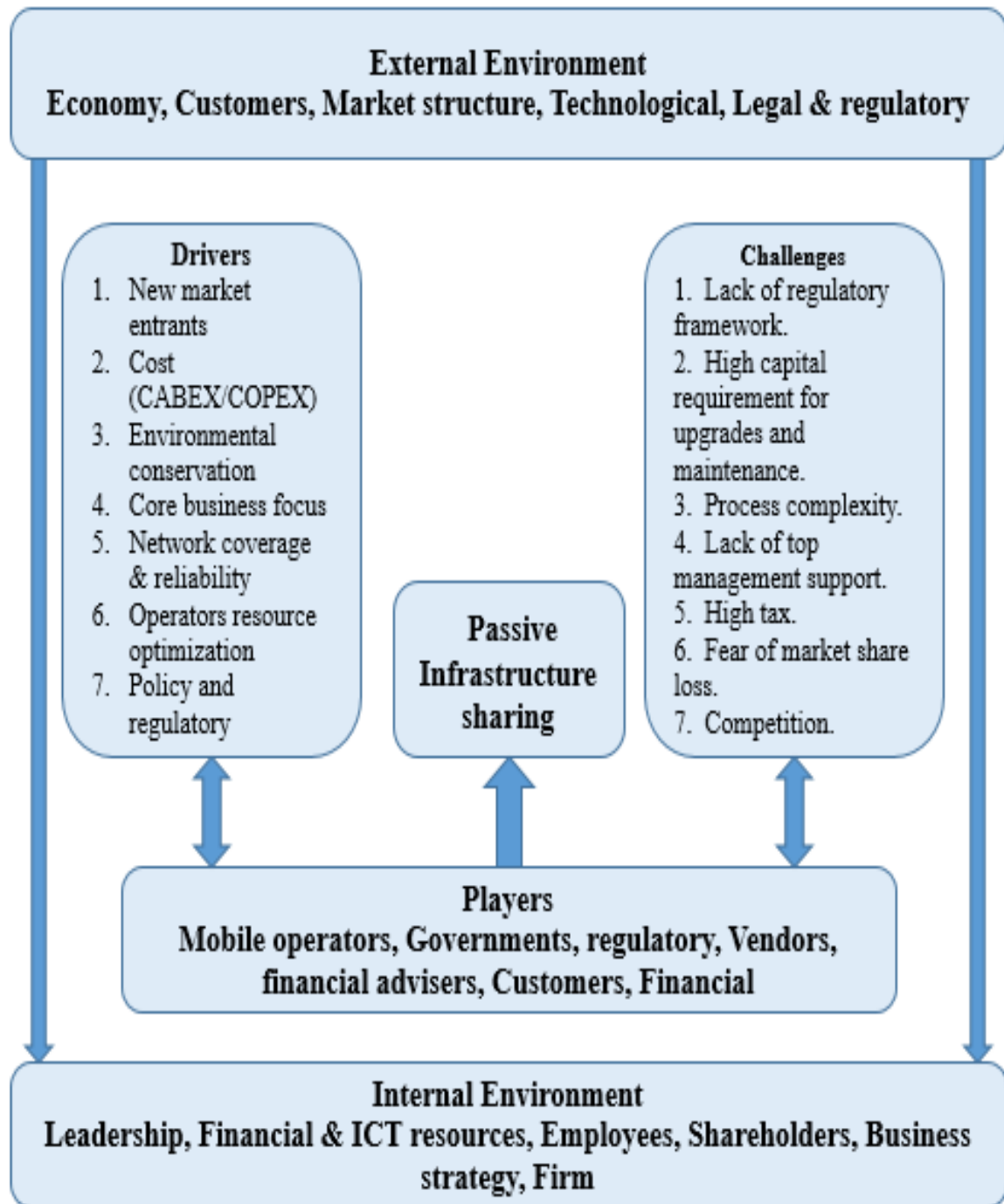Figure 4.1 below presents a summary of the research.

Figure 4.1 Summary of the research.

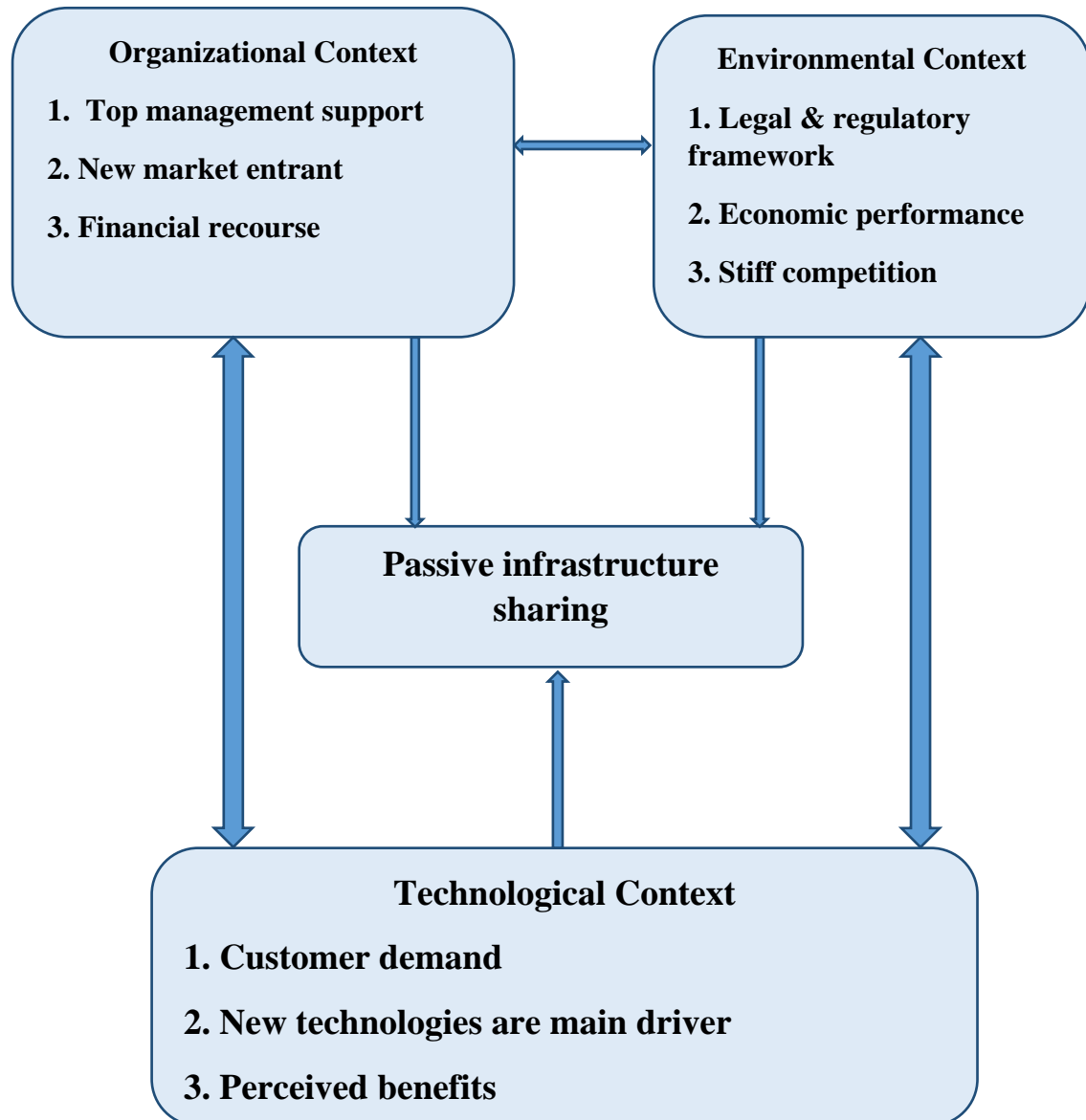## 4.7 Proposed frame work

Figure 4.2. Proposed Infrastructure Sharing Framework

Note:

It must be noted that this study focuses only on the 9 constructs (the first 3 in each context). The scope and flexibility of the TOE framework allows

constructs to be expanded, depending on circumstances, in order to deliver the needed results.

4.8 Chapter Summary

This presents the findings of the study. It also presents the results related to the techniques used in the analysis of the qualitative approach (interviews). The participants pointed out the importance of implementing infrastructure sharing and the most important factors that affect the implementation of this strategy. Furthermore, this chapter presents an analysis using a TOI conceptual framework to facilitate the implementation of mobile infrastructure sharing in Palestine.

Chapter Five

Conclusions and Recommendations

5.1 Chapter Overview

This chapter presents the conclusion of the study and highlights its contribution to the theoretical framework and literature in the field of study. In addition, it offers a guide on infrastructure sharing for managers working in mobile network operators, and suggests some recommendations to be taken into consideration in future research. Moreover, it presents the limitations of the study and offers suggestions for future research. Finally, this chapter summarizes and concludes the main findings of the study.

5.2 Conclusions

Through this research, the researcher seeks to propose the adoption of a well-established framework for mobile infrastructure sharing for mobile operators in Palestine after presenting in details the drivers and challenges of infrastructure sharing among the two mobile operators in Palestine.

The research includes firstly, exploring barriers and drivers of mobile infrastructure sharing, secondly, proposing a framework for mobile infrastructure sharing to be adopted in Palestine. The proposed framework addresses the most important issues that help in the implementation of mobile infrastructure sharing specifically passive sharing, to enable companies reap all benefits of implementation, such as APEX and OPEX

reduction. Moreover, the findings show that sharing strategies are not fully studied in Palestine yet. Results also show that there is a necessity to start sharing strategy in mobile communication sector for the benefits that can be gained from such implementation. The research findings indicate that the most influential factor in implementing infrastructure sharing practice is "top management support" in an organization and "cost reduction in APEX and OPEX" and "competitive advantages", whereas the least influential factor is "environmental conservation".

5.3 Research Contribution

This study contributes to the body of literature about the research topic by responding to the lack of research in the field of the implementation of mobile infrastructure sharing in developing countries, as only few studies have been conducted in this field. However, studying the motives and obstacles of implementing mobile infrastructure sharing requires more attention and focus from the decision makers working in the Palestinian telecommunications sector.

This study adds a link that has not yet been explored in mobile network organizations in developing countries. It provides insight on mobile infrastructure sharing in terms of examining the factors that drive mobile operators to implement sharing and the barriers that prevent such implementation. The study further highlights the most important benefits that can be gained in the Palestinian telecommunications sector from the implementation of mobile infrastructure sharing.

The study highlights the best practices of implementing mobile infrastructure sharing that can be used in Palestinian communication sector and their impact on cost reduction. In addition, this study provides an empirical evidence for the statement that the implementation of sharing mobile network infrastructure enhanced performance in mobile phone organizations. Also it improves and affirms the essential understanding of sharing strategies declared in the previous literature. Furthermore, the study tests the relationship between the external and internal environments and how they affect the implementation of infrastructure sharing. This study is the first study on infrastructure sharing in communication sector in general, and in the Palestinian context in particular.

Finally, the research presents a conceptual framework that discusses how the elements of technology, organization and environment affect the implementation of mobile infrastructure sharing in mobile network operators is developed. This conceptual framework is considered a valid mechanism that helps mangers working in the communication sector to facilitate the implementation and adoption sharing strategies in their organizations which will be reflected in positive performance in the future, and how mobile operators should link their strategic plans with sharing practices to enhance their performance.

5.4 Recommendations

Palestinian mobile operators can improve their mobile network sharing strategies, which will provide many benefits for organizations in term of economic, social and environmental benefits. This section provides some recommendations for top management employees at mobile operators companies to help boost their network and performance. The recommendations are:

- The support of top management and decision makers is key success factor for implementing sharing strategy in any mobile operator. As for the governmental authority, the Ministry of Telecommunication and Information Technology, should implement infrastructure sharing strategies in mobile operators companies, where it has the legal authority to enforce the implementation of infrastructure sharing on telecom companies.

- There is a need for establishing infrastructure sharing strategies departments at mobile operator companies. These departments will bear the responsibilities and duties related to proposing plans and strategies for the implementation of infrastructure sharing. Moreover, an optimization manager should responsible for network rollout among mobile operator stakeholders in Palestine.

- Having regulatory framework owned and supported by mobile phone network stakeholders. Its aim is at organizing the sharing process,

establishing laws and basic rules, and formulating conditions for infrastructure sharing.

- Establish of a third party company that bears the responsibility of managing the infrastructure sharing process for Palestinian mobile operators. Such third party shall conduct research to study of operators' networks, and apply the infrastructure network and manage the entire sharing process in cooperation with the Palestinian Ministry of Communication.

- The competent governmental entity (the Ministry of Telecommunication and Information Technology) must encourage mobile operators to invest more in implementing sharing strategies, as there is a lack of such support from Palestinian communications organizations.

5.5 Research Limitations

The TOE framework developed in this research was developed with a wide scope, which implies that the factors could be expanded or reduced depending on the existing circumstances. The study is limited to the nine factors described in the research, but the factors could vary which will give different results. The second limitation is the political situation in Palestine, which make it hard for researchers to access some cities such as Jerusalem and Gaza Strip. Reluctance of mobile phone operators to disclose numerical information about their companies, such as the number of sites

in each city, expansion plans, real costs, and site construction, also limited the access to information that will support this research.

5.6 Future Research Directions

This study provides basis for future studies to be implemented by other researchers in the field. For example, future research might make TOE framework scope wider and study more constructs (e.g. third party behavior, customer satisfaction, etc) to study their effects on the implementation of mobile infrastructure sharing in the communication sector. Furthermore, more studies should be made regarding the influence of infrastructure sharing practices on the environment. Moreover, the factors proposed in this study regarding the telecommunication sector can be tested in other developing countries to generalize the proposed framework.

5.7 Summary of Chapter

This chapter summarizes the conclusions of the study. It also presents recommendations and guidelines for mangers working in mobile communication operator companies to implementing sharing practices in their organizations to boost performance in communication sector. Furthermore, this chapter presents the limitations that the researcher faced while conducting the study, and finally, it presents directions and opportunities for future research.

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Appendices

Appendix A

An-Najah National University

Faculty of Graduate Studies

Engineering Management Program

Interview Manual

Introduction

This manual is designed to guide the interviewer to conduct a semi-structured interview where the researcher asks open-ended questions. The purpose of the interview is to collected qualitative data from experts in Palestinian mobile operators. The questions are designed based on literature. Therefore, some questions, might be revised, rewritten, or restructured in other ways.

Opening Clause

I would like to thank you for accepting our request to have an interview with you. I would also like to express my appreciation to you for taking out time to answer the questions raised in the interview.

Confidentiality clause

The collected data and information will be used only for the purpose of scientific research. The interviewees names will not be revealed or disclosed unless acceptable to either. Your privacy, therefore, will be our highest priority and responsibility.

Recording

This interview will be audio -recorded unless the interviewee refuses it. The purpose of the recording is to help both the researcher and the interviewers to focus on delivering a good interview, so that the former can refer back to the questions at any time. Most importantly, the recorded interview is used for the transcription process. This helps avoid subjectivity and self-bias in analyzing the answers.

Length of the interview

The interview is expected to last between 60 to 90 minutes.

Regards, Malak Anabousi.

Researcher, Master of Engineering Management

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Mob +972-595-822569

Section I: Interviewee's general information:

Interviewee's name

Position (Job role)

Experience (years

Tel /Mob

E-mail

Date

Time

Section II: Company's general information

Company's name

Annual revenues

Number of employees

Main products

Tel

Address

Website

Section III: General information

1. What form of infrastructure sharing (active or passive) do you prefer most?

□ Active (e.g. switches/routers, radio equipment's, spectrum, antenna, BTS/BSC/RNC)

□ Passive (e.g. towers, power, air conditioners, ducts, security, equipment rooms, mast)

□ Both

□ None

2. Do you support ICT infrastructure sharing in coordination with the Government? Why?

3. Should the Palestinian Ministry of Information Technology and Telecommunication make ICT infrastructure sharing voluntary or mandatory? Why?

4. Should the government give incentives, such as tax and license fee concessions, to mobile network operators who share their infrastructure?

5. Operators with excess capacity should share their information with other ICT operators and the Palestinian Ministry of Information Technology and Telecommunication to enable them to make infrastructure sharing decisions?

6. Which infrastructure sharing business model do you prefer most? Why?

□ Self-Operator controlled

□ Third party controlled

□ Government controlled

7. From your point of view, is the infrastructure sharing decision mainly driven by an operator's desire to reduce capital and operational expenses so as to maximize on profit margins and remain competitive? How?

8. Researcher: How can the operators' initiatives promote infrastructure sharing?

Section IV: Infrastructure sharing drivers and challenges

1. What does the company do in order to generate extra revenue?

2. Does infrastructure sharing facilitate rapid deployment of mobile infrastructure for new operators with better cost of deployment, how?

3. Will the implementation of infrastructure sharing enable operators to focus more on their core business and innovations? Explain?

4. How can infrastructure sharing affect coverage and network availability?

5. What are the drivers of infrastructure sharing?

6. Can infrastructure sharing lead to efficient utilization of scarce resources?

7. What are the barriers of infrastructure sharing in your company?

8. How Sharing exposes operator to risks?

9. How do regulatory and policy frameworks guide operators towards infrastructure sharing?

10. How can your company enhance its market share?

Section V: Factors influencing infrastructure sharing adoption among ICT operators

1. How does the encouragement of mobile operators' managers affect the implementation of infrastructure sharing?

2. How can your company support its objectives through infrastructure sharing?

3. How do technology changes influence mobile network infrastructure sharing adoption in your company?

4. How does your company's economic performance effect its decision to implement cost saving strategies such infrastructure sharing?

5. Does adoption of a legal framework and policies for infrastructure sharing lead to higher adoption of infrastructure sharing? Why?

6. How do you respond to customers' demands for new ICT product/service (e.g. 3G/4G, money transfer)? Does this affect the adoption of infrastructure sharing?

Appendix B

جامعة النجاح الوطنية

كلية الدراسات العليا

برنامج ماجستير الإدارة الهندسية

الجاهزية والحواجز والمحركات لمشاركة البنية التحتية:

إطار عمل لمشغلي الهاتف المحمول في فلسطين

دليل المقابلة

المقدمة

تم تصميي هذا الدليل لتوجيه المحاور لاجراء مقابلة شبة منظمة, حيث طرح الباح اسئلة مفتوحة لغرض جمع البيانات النوعية من خبراء في مشغلي الهواتف المحمولة في فلسطين. تم تصميم الاسئلة من خلال الاعتماد على الادبيات السابقة. لذلك, قد تتم مراجعة بعض الاسئلة او اعادة كتابتها او اعادة هيكلتها بطرق اخرى.

الافتتاح

أود أن أشكرك على قبول طلبنا لإجراء مقابلة معك. كما أود أن أعرب عن تقديري لكم على تخصيص بعض الوقت للإجابة على الأسئلة التي طرحت في المقابلة.

سرية البيانات

سيتم استخدام البيانات والمعلومات التي تم جمعها فقط لأغراض البحث العلمي. لن يتم الكشف عن أسماء الأشخاص الذين تمت مقابلتهم أو الكشف عنها إلا بقبول أي منهم. لذلك ، ستكون خصوصيتك على رأس أولوياتنا ومسؤوليتنا.

التسجيل الصوتي

سيتم تسجيل هذه المقابلة بالصوت ما لم يرفضها المستجيب. الغرض من التسجيل هو مساعدة كل من الباحث والمحاورين على التركيز على تقديم مقابلة جيدة, بحيث يمكن للاول الرجوع الى الاسئلة في اي وقت. الاهم من ذلك, يتم استخدام المقابلات المسجلة لعملية النسخ للمساعدة على تجنب التحيز الذاتي في تحليل الاجابات.

طول المقابلة الشخصية

من المتوقع أن تستغرق المقابلة ما بين 60 إلى 90 دقيقة

الباحثة: ملك عنبوسي

ماجستير الادارة الهندسية

Email: malakanbosi93@outlook.com

Mob +972-595-822569

القسم الأول: المعلومات العامة للمقابلة

اسم الشخص الذي أجريت معه المقابلة :

المنصب (الدور الوظيفي) :

عدد سنوات الخبرة :

الهاتف المحمول :

البريد الالكتروني :

التاريخ :

الزمن :

القسم الثاني: معلومات عامة عن الشركة

اسم الشركة :

معدل العائدات السنوية :

عدد الموظفين :

المنتجات الرئيسية :

رقم الهاتف :

العنوان :

الموقع الالكتروني

القسم الثالث: معلومات عامة

1.ما هو شكل تقاسم البنية التحتية (النشط أو السلبي) الذي تفضله أكثر؟

المشاركة النشطة (الميكروويف ، الطيف ، الخوادم ، أجهزة التوجيه)

المشاركة السلبية (مثل الأبراج والطاقة ومكيفات الهواء والقنوات والأمن وغرف المعدات والخنادق)

2.هل تشجع تقاسم البنية التحتية لتكنولوجيا المعلومات والاتصالات بين الحكومة؟ لماذا ؟

3.هل يجب على وزارة الاتصالات الفلسطينية جعل المشاركة في البنية التحتية لتكنولوجيا المعلومات والاتصالات طوعية أم إلزامية؟ لماذا اا؟

4.هل ينبغي منح حوافز لمشغلي تكنولوجيا المعلومات والاتصالات الذين يتشاركون بنيتهم التحتية مثل الضرائب ورسوم الترخيص؟ تنازلات من قبل الحكومة؟

5.يجب على المشغلين ذوي السعة الزائدة مشاركة المعلومات مع مشغلي تكنولوجيا المعلومات والاتصالات الآخرين ووزارة الاتصالات الفلسطينية لتمكينهم من اتخاذ قرارات تقاسم البنية التحتية؟

6.ما هو نموذج أعمال تقاسم البنية التحتية الذي تفضله أكثر؟ لماذا اا؟

□ تحكم المشغل

□ الشركات المستقلة

7.من وجهة نظرك ، هل قرار تقاسم البنية التحتية مدفوع أساسًا برغبة المشغل في تقليل النفقات الرأسمالية والتشغيلية لزيادة هوامش الربح إلى أقصى حد والحفاظ على المنافسة؟ كيف؟

8.كيف يمكن لمبادرة المشغل أن تعزز تقاسم البنية التحتية؟

القسم الرابع: محركات وتحديات تقاسم البنية التحتية

1.ماذا تفعل الشركة من أجل تحقيق إيرادات إضافية؟

2.هل يتيح تقاسم البنية التحتية للوافدين الجدد إطلاق خدماتهم وتسويقها بسرعة أكبر. كيف؟

3.هل يمكن لمشاركة البنية التحتية أن تمكن المشغلين من التركيز على الأعمال والابتكارات الأساسية؟ يشرح؟

4.كيف يمكن أن تؤثر المشاركة على التغطية وتوفر الشبكة؟

5.ما هي دوافع تقاسم البنية التحتية؟

6.هل يمكن أن يؤدي تقاسم البنية التحتية إلى الاستخدام الفعال للموارد الشحيحة؟

7.ما هي عوائق تقاسم البنية التحتية في شركتك؟

8.كيف تعرض المشاركة المشغل للمخاطر؟

9.كيف يوجه الإطار التنظيمي والسياسي المشغلين لمشاركة البنية التحتية؟

10.كيف يمكنك تحسين حصتك في السوق؟

القسم الخامس: العوامل المؤثرة في اعتماد تقاسم البنية التحتية بين مشغلي تكنولوجيا المعلومات والاتصالات

1.كيف يؤدي دعم الإدارة العليا لشركتك إلى تبني مشاركة البنية التحتية؟

2.هل من المرجح أن يتبنى المشغلون الجدد تقاسم البنية التحتية لتسويق خدماتهم بسرعة وتوفير نفقات نشر الشبكة والتشغيل؟ لماذا ا؟

3.كيف يمكن لشركتك دعم أهدافها من خلال تقاسم البنية التحتية؟

4.كيف تؤثر التغييرات التكنولوجية على تبني البنية التحتية لتكنولوجيا المعلومات والاتصالات بين شركتك؟

5.كيف يؤثر الأداء الاقتصادي على شركتك لتنفيذ استراتيجيات توفير التكاليف مثل اعتماد مشاركة البنية التحتية؟

6.هل الإطار القانوني والسياسة القائمة على تقاسم البنية التحتية يؤدي إلى اعتماد أعلى لمشاركة البنية التحتية؟ لماذا ا؟

7.كيف تستجيب لطلب العملاء على منتج / خدمة جديدة لتكنولوجيا المعلومات والاتصالات مثل تقنية الجيل الثالث من الاتصالات وخدمات تحويل الاموال؟ هل يؤثر على اعتماد تقاسم البنية التحتية؟

Appendix C

Table 1: experts and arbitrators who review the questioners

Number	Position
3	Teaching staff at An-Najah University
3	Mobile network experts
1	Engineering management experts

جامعة النجاح الوطنية

كلية الدراسات العليا

الجاهزية والحواجز والمحركات لمشاركة البنية التحتية: إطار عمل لمشغلي الهاتف المحمول في فلسطين

اعداد

ملك اياد عنبوسي

اشراف

د.سعد طربية

ب

الجاهزية والحواجز والمحركات لمشاركة البنية التحتية:

إطار عمل لمشغلي الهاتف المحمول في فلسطين

اعداد

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اشراف

د.سعد طربية

الملخص

يعد قطاع تكنولوجيا المعلومات والاتصالات من أهم القطاعات وأكثرها تطورًا في فلسطين.ان تكنولوجيا المعلومات والاتصالات لها دور رئيسي في التنمية الاقتصادية للبلاد, حيث يسعى مشغلين شبكات الهاتف المحمول باستمرار إلى تقديم خدمات بأعلى جودة لمستخدميهم وتحقيق أعلى أرباح ممكنة. يتبنى المشغلون الحاليون (جوال و اوريدو)، نموذج شبكة منفصل، بدلاً من نموذج الشبكة المشتركة. الهدف من هذا البحث هو دراسة المعوقات والدوافع المتعلقة بمشاركة البنية التحتية لشبكات المحمول في فلسطين، واقتراح إطار لمشاركة البنية التحتية. هناك العديد من التجارب الناجحة لأنواع مختلفة من مشاركة البنية التحتية حول العالم ، كما هو الحال في الهند وفرنسا وهونج كونج ودول أخرى. ولتحقيق هدف هذا البحث اعتمد الباحث المنهج النوعي, حيث تم جمع البيانات والمعلومات المطلوبة من خلال 20 مقابلة شبه منظمة أجراها الباحث مع خبراء في مجال الاتصالات. ولخلص الباحث نتائج البحث إلى أن الدوافع الأكثر تأثيراً على اعتماد قرار مشاركة البنية التحتية للهاتف المحمول في فلسطين هي ان المشاركة تعمل على تقليل النفقات الرأسمالية والتشغيلية، بالإضافة إلى نشر خدمات الهاتف المحمول بشكل أسرع للمشغلين الجدد، وتوسيع تغطية الشبكة وتحسينها، وتحسين جودة الخدمات. من ناحية أخرى ، كانت العوائق الأكثر تأثيرًا هي عدم وجود إطار تنظيمي ينظم آليات وقوانين تقاسم البنية التحتية، والتعقيدات التي قدمها كبار مديري مشغلي شبكات الهاتف المحمول وعدم التشجيع والدعم للموظفين لبدء صياغة استراتيجيات لمشاركة البنية التحتية . علاوة على ذلك يقترح هذا البحث اطار عمل لتطبيق مشاركة البنية التحتية للهواتف المحمولة في فلسطين من خلال دراسة عدة عوامل تؤثر على اعتماد قرار

ج

المشاركة. يساهم البحث بدراسة اهم العوامل التي تؤثر على تطبيق مشاركة البنية التحتية للهواتف المحمولة التي تم الكشف عن بعض منها في الدول النامية الاخرى. هذه دراسة رائدة في مجال اتصالات الهاتف المحمول، وقد لقيت استحسانًا كبيرًا من قبل مشغلي الهاتف المحمول الفلسطينيين، لا سيما مع منح تصريح استخدام الجيل الرابع من الهواتف المحمولة في فلسطين.