

Evaluating Project Management Methodologies in Yemen`s Telecommunications Sector: Challenges and Solutions for Sustainability

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Abstract

In light of the complex challenges currently facing humanity, including climate change, rapid population growth and global economic and political turmoil, it has become imperative to develop and implement effective strategies to address these issues. Project management (PM) represents a business solution to address complex issues, as well as to ensure the continuity and availability of resources for the future. Although the discipline of project management originated in the early 20th century, it has undergone continuous evolution in response to the evolving needs of business. The project management approach is contingent upon the nature of the issue being addressed and the complexity of the project. In order to achieve the greatest success, organizational leaders seek to align the project management style with the specific project in focus. The telecommunications sector plays a pivotal role as a platform for technological and management innovations. As the second most important sector in Yemen after the oil sector, the sustainability of this sector is of paramount importance in order to ensure tangible progress in the country's development. This thesis

examines the effectiveness of modern project management methodologies in promoting sustainability in this pivotal sector.

This study employs a multi-method research design to collect quantitative data from 150 professionals in leading telecommunications companies. Additionally, it incorporates qualitative insights from 22 in-depth interviews with project managers and key stakeholders to evaluate the current state of the industry with regard to the strategies employed to manage telecommunications projects and ascertain whether these strategies facilitate sustainability in the sector. The analysis reveals a high level of familiarity and application of project management methodologies, including Waterfall, Agile. Some projects have adopted sustainable practices, such as energy efficiency, there is a lack of proper training, regulatory challenges.

Keywords: Project Management Methodologies, Sustainable Development, Telecommunications Sector.

Introduction

Project management and sustainability are both currently considered hot topics by managers. In fact, there is an increasing interest in developing and proving new managerial practices for project management (PM), and principles of sustainability dominate every context of business and organizational management. Therefore, the integration of these two fields represents the future for project-based organizations.

Projects are influenced by the environment in which they are carried out, but they also contribute to the change of the same environment. From a sustainability perspective, the project delivery phase and the final deliverable produce impacts that could be particularly advantageous in the present, but could have negative effects for many stakeholders in future scenarios. In other words, to produce the deliverables for which it was undertaken, each project uses energy and produces social, economic, and environmental (SEE) impacts, which define the degree of sustainability of the

project as a whole. Projects are based on temporary endeavors that, consuming resources, deliver beneficial objectives. Sustainability defines criteria for proper use of resources and for the evaluation of outputs in terms of economic, social, and environmental impacts.

Sustainability, as field of study, can provide project management with new perspectives, supporting project managers in their decision-making about planning, management, and control of the resources assigned to the project, considering the economic, social, and environmental impacts of not only the project life cycle, but also the asset's life cycle and the life cycle of the products this asset produces. [Armenia, S., et al. (2019)].

The Telecommunication sector is experiencing and substantial changes in how it creates and offers its services due to various technological, market, regulatory, and competitive factors.

According to the Al-Sharafi, M.A.A.; Tong, S.; Aloqab, A. 2021, the telecommunication sector, which is considered one of the main pillars of any society and admitted as the most profitable industry globally, is going fast through many dramatic changes in producing services. According to the world bank report in 2004, [telecommunications is deemed one of the three primary utility industries (water, electricity, and telecommunication) and involves the most competition].

As the telecommunications infrastructure grows, the requirement of the electricity, to provide power to it, increases. Partially, the electricity is obtained from the power grid and the rest through burning of fossil fuel, for example diesel. But these sources lead to the emission of greenhouse gases (GHG) with hazardous environmental impact. hazardous impact of climate change has drawn a lot of attention across the globe and thus, people have become concern and conscious for the same. Presumably, ill climate change instances like temperature increase, melting of

glaciers, rising of sea level, natural calamities are results of greenhouse effect which is caused by the emissions from burning fossil fuels to generate energy. Sustainability in business has become crucial wherein the objective is to minimize the impact on the environment in addition to creating products and offering services ethically. [Nishant Mehra, (2020)].

Background of the Study

In the past the telecommunications sector in developing countries has largely been a playing field for engineers and technicians. This is no longer true. Today, telecommunications sectors are large complex systems involving governments, engineers, policy makers, customers, vendors, investors and many other stakeholders. In fact, today all of us rely on continuous information throughout our personal and professional lives. [Marvine Hamner et al., (2017)].

In the telecommunications sector, sustainability is very important as the sector grows rapidly and has vast infrastructure that runs upon energy. This sector now covers more than 90% of human settlements. It has a direct impact on environment. Therefore, the sector should be made sustainable in all aspects. [Nishant Mehra, (2020)].

Currently, PM is applied in contexts with high degree of innovation, characterized by uncertainty and high technical-organizational complexity. The discipline of project management is integrated into the industrial sector and management activities, as well as the utilities sector and public administration. The fundamental principles that underpin project management are time, cost and quality. [E. Fregonara, (2017)].

Silvius and Schipper [Peterson, H. (2009)], conclude that the concepts of sustainability should be integrated in the way projects are planned, organized, executed, managed and governed. This sustainability perspective on project

management [Novak, J. D. and Gowin, D. B. (1984)]. evolved into the concept of Sustainable Project Management, which is defined as “the planning, monitoring and controlling of project delivery and support processes, with consideration of the environmental, economic and social aspects of the life-cycle of the project’s resources, processes, deliverables and effects, aimed at realizing benefits for stakeholders, and performed in a transparent, fair and ethical way that includes proactive stakeholder participation. [Peterson, H. (2009)].

Problem Statement

In the context of the ongoing war's impact on the telecommunications sector in Yemen, this sector is confronted with considerable challenges in terms of providing effective and sustainable services. These challenges include the destruction of infrastructure, restrictions on equipment imports, institutional divisions, and double taxation.

This study aims to explore the potential of modern project management methodologies, to enhance the efficiency and sustainability of telecommunications projects in Yemen. It examines the role of these methodologies in overcoming challenges and achieving sustainable development goals in this vital sector.

Yemen's telecommunications sector is of significant economic importance. It is the second-largest source of public revenue after petroleum, and its growth is vital for economic growth and social development. It provides employment opportunities both directly and indirectly. [DeepRoot Consulting, Sana’a Center for Strategic Studies, & CARPO – Center, 2021].

Objectives of the Study

To analysis and identify the project management methodologies currently used in telecommunication sector in Yemen.

To assess the compatibility of these methodologies with environmental, economic, and social sustainability requirements.

To identify the challenges and obstacles faced in implementing current project management methodologies to achieve sustainability goals.

To propose solutions and strategies to overcome these challenges and improve the efficiency and effectiveness of these methodologies in achieving sustainability.

Research Questions

1. What are the current project management methodologies used in the telecommunications sector in Yemen?
2. What obstacles must be overcome to achieve sustainable results using these methodologies?

Significance of the Study

The importance of this study, which utilizes a mixed methodology combining qualitative and quantitative approaches, lies in its potential to make significant contributions to the field of project management in telecommunication sector in Yemen. By achieving the study's objectives, several key benefits can be realized:

1. Enhanced Understanding of current Methodologies:

By analyzing and identifying the project management methodologies currently used in the sector, the study will provide a comprehensive overview of the prevailing practices. This understanding is crucial for stakeholders, including project managers, and policy makers, to recognize the strength and limitations of existing methodologies.

2. Alignment with Sustainability Goals:

Assessing the compatibility of current methodologies with environmental, economic, and social sustainability requirements will highlight areas where improvements are needed. This alignment is essential for ensuring that projects contribute positively to sustainable development goals, which are increasingly becoming a priority in the global and local context.

3. Identification of Challenges:

By identifying the challenges and obstacles in implementing current project management methodologies to achieve sustainability goals, the study will uncover critical barriers that need to be addressed. This insight is valuable for practitioners and researchers aiming to refine and adapt methodologies to better suit the unique context of Yemen's telecommunications sector.

4. Proposed Solutions and Strategies:

Proposing solutions and strategies to overcome the identified challenges will provide actionable recommendations for improving the efficiency and effectiveness of project management practices. These strategies can help organizations better manage resources, reduce waste, and enhance stakeholder value, ultimately leading to more sustainable project outcomes.

5. Contribution to Academic and Practical Knowledge:

The study will contribute to the academic body of knowledge by filling gaps related to the specific context of Yemen's telecommunications sector. Additionally, it will offer practical insights that can be directly applied to improve project management practices, benefiting both the industry and the wider community.

Literature Review

Telecommunication commonly referred to as ‘Telecom’ can be defined as the exchange of information over a significant distance by means of electrical or electronic devices like telephone, radio, mobile phones, VoIP, broadcast networks, etc. What are Telecommunications? It has been recorded in the history that the early telecommunication started using smoke signals and drums as a means to convey the messages and in the 19th-century telephone was invented by Graham Bell. Since then, there has been a tremendous technological development in the field of telecom with the introduction of new and complex technologies in the Telecommunication industry, there was a need for the telecommunication companies to be more efficient. [Swapnil Narvekar, 2018].

- **Yemen’s Telecommunication Sector**

Telecommunications are a vital pillar of Yemen’s economy. The sector’s contribution to economic output has been growing steadily at an average of 7% between 2015 and 2018, with a large number of jobs being directly or indirectly linked to the sector. Its impact on public finances is considerable: fiscal receipts from telecommunications (mostly fees and taxes levied from mobile carriers) make up the largest share of public revenues. While lacking official figures, multiple sources suggest that telecommunications sector revenue are likely to exceed USD 150 million.

Notwithstanding their economic and social importance, Yemen’s telecommunications acutely underperform regional and global trends in terms of access, quality, and costs. Access to telephone services, particularly mobile-based services, has slightly contracted since the start of the war. As of 2017, only 27% of the population had access to some form of Internet connectivity, which compares very poorly to the averages for the Middle East and Northern Africa (MENA) region

(65%) and the world (49%). Not only is access limited, but quality is also among the poorest in the world, given the abysmally low speed of Internet services and the low bandwidth capacity available to users. Additionally, the costs of telecommunications services, especially Internet, are prohibitive: a data-only mobile broadband package cost 10% of monthly GNI (gross national income) per capita, well above the UN 2% affordability target for entry-level broadband services to be reached by 2025.

Yemen's telecommunication sector is poorly developed, with only 27% reporting to have access to Internet services. Internet connectivity is also abysmally slow and unstable by world and regional standards, although affordability has been improving with the recent introduction of 4G services. Poor connectivity has had negative consequences for both economic productivity and social interactions. While social norms and unfavorable geographic conditions have played an important role in excluding marginalized communities from access to these services, a traditionally weak regulatory environment and inefficient, often highly politicized policymaking have held back private investment in the sector over the years.

Developing modern, reliable, and accessible telecommunications services in Yemen is key to the country's sustainable socio-economic development. [Fadhl, S., & Sacchetto, C. (2023, February)].

Managers, engineers, policy makers... all stakeholders must understand that the introduction of reform must be accompanied by a thorough understanding of the sector's needs, demands and different environments, e.g. social, political, economic or technological. [Marvine Hamner et al. (2017)].

The network is sharing between the operators in the core and radio access networks emerging as a more radical technique for improving network costs significantly and sustainably. [D.-E. Meddour, T. Rasheed, and Y. Gourhant, 2014.], 2021 International Congress of Advanced Technology and Engineering.

The network sharing technologies in Middle East countries focus on internet banking, e government, and e-commerce areas. In Yemen, ISTC focuses on management information systems adoption among the employees at telecommunication companies. However, there is a lot of shortcoming of studies in the field [Y. H. Al-Mamary, A. Shamsuddin, and N. A. Abdul Hamid, 2015].

- **Telecommunications Infrastructure:**

International connectivity: Submarine cables, terrestrial cables, and satellites:

Five submarine fiber-optic cables could provide international connectivity to Yemen. These are Aden-Djibouti, Africa-1, Asia-Africa-Europa 1 (AAE-1), FALCON, and SEA-ME-WE 5.

Besides the FALCON and Aden-Djibouti cables, all other cables are currently not operational. This is due to a number of factors, including natural disasters, military attacks, and the political and institutional fragmentation that has resulted from the conflict. In particular, state-owned TeleYemen (the country's wholesale operator responsible for providing international connectivity) has encountered difficulties in accessing SEA-ME-WE 5 and AAE-1. These were recent investments, designed to land in Yemen, and capable of providing the country with modern, high-quality connectivity. Yemen's participation in the cables' consortia cost USD 70 million in prepaid membership fees (USD 40 million for AAE-1 and USD 30 million for SEA-ME-WE 5), which would grant the right to 200 Gbps of capacity, expandable over time. The only two operational cables – especially Aden-Djibouti – are old, inadequate to sustain modern broadband growth, and have limited capacity. Current demand from operators exceeds the capacity of international cables. [Interview with MoTIT- official; Oxford Business Group, 2016; Djibouti Telecom, 2022].

Given the very low capacity of the Aden-Djibouti gateway, whose services do not extend beyond the Aden region, capacity from FALCON is used to supply the entire country with international connectivity. [Arabian Brain Trust, 2022].

Relying on only a few links for international connectivity is risky and sub-optimal. First, it exposes the system to concrete risks of single point failure. For example, in January 2020, unintentional damage to FALCON by a vessel passing through the Suez Canal led to an 80% percent drop in the Internet capacity for almost a week across the country. Second, the quality of telecommunications services is likely to be reduced due to lower redundancy and resilience.

Yemen receives coverage by more than 9 satellites in the Ku, Ka, and C bands. These are operated by Intelsat, Arabsat, Amos, and others. despite the significant potential that satellite terminals could have in terms of expanding Internet access, especially in remote regions, imports and operations are significantly restricted by the security embargo on telecommunications equipment. [Fadhl, S., & Sacchetto, C. (2023, February)].

Table1. Status of submarine and land cables landings in Yemen - Source: Noaman, K. A. W. (2020)

Cable	Location	Type	Statuses	Causes of inactivity
Aden-Djibouti	Aden, Aden	Submarine fiber-optic	Operating	-
AAE-1	Aden, Aden	Submarine fiber-optic	Not operating	Conflict & institutional fragmentation
FALCON	Al-Hodeida, Al-Hodeida Al Ghaydah, Al Mahrah	Submarine fiber-optic	Operating	-
SEA-ME-WE 5	Al-Hodeida, Al-Hodeida	Submarine fiber-optic	Not operating	Conflict & institutional fragmentation
Africa-1	Mocha, Taiz	Submarine fiber-optic	Not operating	Not linked to Yemen
Haradh land port	Haradh, Hajjah Alab, Sa'dah	Land fiber cable (KSA)	Not operating	Damaged by conflict
Al Wadeha land port	Al Wadeha, Hadramout	Land fiber cable (KSA)	Operating	-
Shahin land port	Shahin, Al Mahrah	Land fiber cable (Oman)	Not operating	Damaged by Laban Hurricane 2019

• **National Backbone and Inter-City Network:**

Yemen's domestic telecommunications infrastructure has been poor since before the conflict. Prior to it, Yemen's Public Telecommunication Corporation (PTC) controlled 32,135 km of copper line network and 12,181 km of fiber-optic cables, connecting all major cities and cable landing stations. The national fixed backbone network consists of copper networks and underground and aerial fiber, both of which are outdated and not suited for high-speed Internet. [Othman, 2019]. With the war, the network has suffered severe damage and only partly functional. [Arabian Brain Trust, 2022]. As of 2018, only 50% of the fixed lines providing telephone and Internet in the country were active. [World Bank, 2020a].

Lack of resources to restore and expand the fixed network, especially through more effective fiber-optic cables, and ongoing military attacks have resulted in low quality and unreliable telecommunications services for citizens and businesses. Notably, the state retains a monopoly over all international and backbone infrastructure.

Due to the infrastructure weaknesses, coverage of telecommunications services is limited, which constrains access. With regards to Internet services, 2G coverage is quite widespread across the national territory, with the exception of the sparsely populated areas in the North, North-west, and West (with the exception of the coast). 3G and 4G services are provided by a few public and private providers and their geographical coverage is limited but expanding (see Table 2 for a summary of these technologies).

Table 2: Telecommunications technologies and services

Generation	Network	Key services
2G	GSM	<ul style="list-style-type: none">• SMS, voice calls, and MMS.• No video calls.• Limited broadband speed (236 kbps).
3G	WCDMA	<ul style="list-style-type: none">• SMS, voice calls, video calls, MMS.• Medium broadband speed (21 Mbps).
4G	LTE	<ul style="list-style-type: none">• SMS, voice calls, video calls, MMS .• High broadband speed (1 Gbps).

Yemen's telecommunications providers can be classified into four categories: fixed telephone, mobile networks, international calls, and Internet service providers (ISPs), as described in Table 3.

Table 3: Telecommunications service providers in Yemen

Fixed telephone	Mobile network	International calls	Internet
Public Telecom Corporation (PTC)	Yemen Mobile	TeleYemen	Yemen Net
	Sabafon		TeleYemen
	Y-Telecom/Hud Hud Telecom		
	YOU (former MTN)		

Landline telecommunications services under the management of state-owned Public Telecom Corporation (PTC). PTC owns and oversees Yemen's backbone infrastructure (copper and fiber optic lines). Moreover, it owns 100% of Yemen Net, 75% of TeleYemen, and 59% of Yemen Mobile.

Mobile-network providers in Yemen include private operators Sabafon, Y-Telecom, and Yemen Oman United Company (YOU, formerly MTN) and state-owned Yemen Mobile. Yemen Mobile has the largest market share (40% or 7.4 million users). The combined market share of the private sector share is 60%. Until recently, Sabafon was the largest private provider (28% or 5.2 million subscribers), followed by YOU (27% or 5 million users), and Y-Telecom, a smaller provider with more limited geographical coverage (5% or 930,000 users). With regards to cellular network operating lines, as of 2019, Sabafon and YOU control over 55% of the total, followed by Yemen Mobile (40%) and Y-Telecom (5%). [MoTIT, 2019].

Since early 2022, the high-speed Internet service market has seen greater private sector participation, with IRG and DFA both granting 4G licenses to most operators. In early 2022, YOU and Yemen Mobile started offering 4G Internet services in the Sana'a region and are now expanding to several cities and governorates in both DFA- and IRG-controlled territories.

Table 4: *Retail mobile operators

Operator	Market share & subscribers (mln)	License	Coverage	Spectrum allocations	Ownership
Yemen Mobile	40.2% 7.47	4G	National	824–834 MHz (uplink) 869–879 MHz, 1032 MHz (downlink)	<ul style="list-style-type: none"> • PTC (59.3%) • Other government shareholders (17.1%) • Private shareholders (23.5%)
Sabafon-Aden/ Sabafon-Sana'a	28.1% 5.23	GSM (2G, 2.75G)	IRG-territories (Sabafon-Aden), DFA-territories (Sabafon-Sana'a)	2x11.2 MHz 900 MHz 2x10 MHz 1800 MHz	<ul style="list-style-type: none"> • Sabafon-Aden • Al-Ahmar Group (60%) • Batelco (26.9%) • Others (13.1%) • Sabafon-Sana'a • Controlled by of DFA's Judicial Guard.
YOU	26.7% 4.96	4G	DFA-territories	2x11.2 MHz 900 MHz 2x10 MHz 1800 MHz	<ul style="list-style-type: none"> • Emerald International Investment LCC (97.8%) • Others (2.2%)
Y-Telecom / HudHud	5.0% 0.93	4G	Not yet operational (Y-Telecom) DFA-territories (Hud Hud)	2x8 MHz in 900 MHz (mainband)	<ul style="list-style-type: none"> • Y-Telecom-Aden • Yemeni business people HudHud Sana'a • Controlled by of DFA's Judicial Guard

World Bank, 2020a; MoTIT-DFA, 2019. Market share as of 2019; subscribers as of 2019; spectrum allocations as of 2020; ownership as of 2022.

*A recent report provides a different ownership structure for YOU, namely: 52% DFA, 30% Al Baloshi (an Omani business), 11% Ibrahim Al Swedi, 4% Al Zomord company, 3% Hayel Abdullhaq. (Regain Yemen, 2022). Y-Telecom was owned by Kuwaiti and Saudi investment companies and investors from the private sector in Yemen, the United Arab Emirates, and Syria until declaring bankruptcy in Sana'a's Commercial Court in 2020. [Regain Yemen, 2022].

Socio-Economic Implications of Telecommunications in Yemen

Telecommunications are a key pillar of Yemen's economy and infrastructure and have large economic and social impacts.

- **Direct Economic Contributions:**

Historically, the telecommunications sector has had large macroeconomic and fiscal impacts in Yemen. Its direct contribution to GDP has been substantial, at about 7% between 2015 and 2018, and has mostly increased year-on-year. [Yemen Central Statistical Organization, 2017], In addition, the sector represents an important source of employment. It is estimated that in 2013 telecommunications generated 29,000 direct jobs, including mobile service distributors and retailers. the World Bank stated that the sector is the largest employer in the country today. [UNESCWA, 2013; World Bank, 2020c].

Telecommunications are also a key source of public revenue, second only to (declining) oil receipts. Telecommunications revenues are mainly composed of licensing fees and taxes charged to operators. On the tax side, this includes a 50% and 35% corporate tax rate on mobile service and international telecommunications service providers, respectively, and a 10% sales tax on domestic and international mobile phone calls. [World Bank, (2020a)]. Unlike taxes, telecommunications fees such as spectrum and operating licensing fees are denominated in foreign currency (mostly USD). fees have historically had a stabilizing effect on the YER.

- **Indirect Economic Contributions:**

Telecommunications are also a critical enabler of economic activity in other sectors. Despite significant challenges, Internet access is allowing citizens to perform daily business tasks such as transfer of documents and financial transactions by money exchange companies, especially during prolonged electricity blackouts. The combination of high demand and an unreliable national backbone network is also

fueling the spread of small-scale local networks in major cities, towns, and villages and thus to a growing number of businesses linked to telecommunications services. [SMEPS' 2019 Rapid Business Survey]. Structural sectoral weaknesses and consequences of the war hold back telecommunications' direct and indirect economic potential. Importantly, lack of connectivity is keeping Yemeni businesses from integrating in local, regional, and global trade networks and value chains, while preventing the diaspora from leveraging business opportunities in the country. [Arabian Brain Trust, 2022]. This is exacerbated by the unreliability of electricity services that prevents businesses from carrying out daily activities, particularly those dependent on Internet connectivity. Ultimately, Yemen's long-term digital development, which would involve government service delivery through e-governance (such as e-education, and e-health), mobile money, cash transfers, digital identification, and energy provision through smart power grids – will rely heavily on the availability and robustness of the national telecommunications infrastructure.

- **The Social Role of Telecommunications:**

Telecommunications also play an important social role in Yemen. Notably, the adoption of technological devices (e.g., smartphones), Internet access, and the use of social media is rising.* In the context of the war, voice and SMS communications and access to the Internet are allowing Yemenis to stay informed and updated about relevant political and security developments, connect with relatives and communities (including the diaspora), and overcome challenges in communication, partly created by absent or weak postal services. Further, the effectiveness of humanitarian and emergency relief operations critically hinges on reliable communications across the country. [Fadhl, S., & Sacchetto, C. (2023, February)].

- **Impacts of the Conflict on Telecommunications:**

Yemen's ongoing war has triggered a deep economic, social, and humanitarian crisis. From a geopolitical perspective, the country remains split into multiple areas of political and economic control. DFA controls most northern and western

governorates where over 70% of the population lives, whereas IRG and its aligned forces retain control over southern and eastern governorates, parts of Al-Hodeidah, Taiz, and Marib. [Geographic control as of 2022. International Crisis Group, 2022].

The war has had a severe impact on Yemen's economy, crippling its key sectors. The IMF estimates that economic output contracted by 48% from the start of the conflict in 2014 to end-2020, with per capita income falling from over USD 1,500 to about USD 580 over the same period. In 2021, GDP suffered a slight contraction at -1%.89 For 2022, a mild recovery is expected, with a projected GDP rate of +2%. [international monetary fund (IMF) (2021a)].

Damage to the telecommunications sector due to the fighting has been substantial, with over 25% of the sector's infrastructure being irreversibly impaired. Wartime losses for the sector amounted to USD 4.1 billion as of March 2022, according to MoTIT-DFA. [Al-Bashiri, 2021], As a result, services are frequently disrupted for prolonged periods of time, with patchy and unstable access, shrinking geographical coverage, and soaring reconstruction and service restoration costs, amounting to tens of millions of dollars. In particular:

- Mobile network damage, The mobile network has been severely damaged, causing the (already weak) national mobile footprint to contract by 40% and making inoperable 200 of the 850 national fiber transmission stations. (Al-Bashiri, 2021). Total recovery and reconstruction costs (including infrastructure reconstruction and service delivery restoration) of the mobile segment of the sector in 16 cities assessed by a World Bank study are estimated between USD 6.1 million and USD 7.5 million.
- Fixed network damage, Damage to the national fixed backbone infrastructure, on which mobile networks rely, accumulated to over USD 47 million as of end-2017. This figure increases to USD 603 million if revenue losses and higher operating expenses are factored in. (World Bank, 2020a; World Bank,

2020c). Aerial cables have been especially exposed to attacks because they are more visible targets. [Halewood and Decoster, 2017].

- International connectivity infrastructure damage Only a portion of the international connectivity infrastructure is functional. Due to physical attacks, natural disasters, or disputes between the parties, only two out of the five submarine and one out of the three land cables are currently operational, namely FALCON, Aden-Djibouti, and Al Wadea. relying on only a few links for international connectivity has negative implications for the quality of telecommunications services as it exposes them to the risk of a single point of failure, reducing redundancy and resilience. This became evident in January 2020 when unintentional damage to the FALCON cable by a vessel passing through the Suez Canal led to an 80% percent drop in the Internet capacity for almost a week across the country. The cities of Al-Hodeidah, Sada'a, and Dhamar have suffered the greatest losses: 32% of their telecommunications infrastructure have been fully damaged and 23% partially damaged. [Fadhl, S., & Sacchetto, C. (2023, February)].
- Maintenance, improvement, and expansion of existing infrastructure and services have been limited since the beginning of the conflict. Operators cannot safely or economically service, repair, replace, and upgrade damaged infrastructure, and the ongoing import blockage acts as a further hindrance to sourcing new equipment.
- In addition to physical damage, inter-party disputes over the management and authority of the sector and its assets contribute to poor functioning and unreliability.

The Concepts of Sustainability

The term 'sustainability' has been interpreted and used in different ways. It basically means to operate in a way that may be sustained indefinitely, that is, to generate

something without thereby depleting or destroying the necessary (re)sources. A prominent example is overfishing. If too many fish are caught in a certain period of time, fish stocks cannot reproduce themselves fast enough in order to fulfil the fishing needs of the consecutive year. If continued, it leads to extinction of the whole fish population, and the fishing industry cannot be sustained. Another example is the depletion of oil reserves. If we continue using petrol products at current level, oil reserves will be exhausted, and future generations will not be able to produce oil products at all, which will bring many industries to a halt, and reduce the availability of many oil based products that currently bring comfort to our lives. There are natural resources which are limited and irreversible, most of which will be thoroughly depleted sooner or later. Resources used through human activities, such as manufacturing, further cause environmentally negative repercussions. Sih, Ferrari, and Harris (2011) argue that human activities can change most organisms in environments. The planet provides the habitat in which people can implement activities. Therefore, how to make use of overarching resources without causing environmental degradation (e.g., minimized damage to surroundings) has become the prominent subject and responsibility with which every person should be concerned.

The term sustainability can also be applied to people. If an employee works too hard over a long period of time, he or she may suffer from burn-out syndrome and may not be able to work again; he/she thus had an unsustainable working style.

Sustainable development has been defined as ‘development that meets the needs of the present without compromising the ability of future generations to meet their own needs’ (World Commission on Environment and Development 1987). This definition is widely used, and has often been interpreted as an appeal to only consume in such a way that we do not destroy too many resources, especially the environment, to allow future generations to have a good quality of life. The core of many concepts of sustainability is that sustainable development implies a move towards economic prosperity, environmental protection and social equity. Developments in one

dimension should not compromise the other dimensions. [Silvius, G., Schipper, R., Planko, J., van den Brink, J., & Köhler, A. (2012)].

sustainability in The business Context: The concept of sustainability is based on balance or harmony between the three dimensions: social equity, environmental protection and economic prosperity. In the business world these three dimensions are often called ‘people, planet, profit’ or PPP. The PPP concept implies that a company should take its decisions with consideration of people – its employees as well as other stakeholders and society – and the planet – that is, the environment – as well as profit. Since the primary goal of most companies is to generate shareholder value, the ‘profit’ dimension is well represented in business strategies and policies. Almost by definition, companies are organized with a strong orientation towards the economic perspective. The environment and the social perspectives, however, are often less embedded in a company’s strategies and practices. Hence, organizations who try to contribute to more sustainable development of our world should focus more on the reduction of the negative environmental and social impacts of its operations while maximizing positive environmental and social impacts. Silvius, (2017) defined the integration of sustainability with project management as a new school of thought.

The six principles of sustainability are:

1. Sustainability is about balancing or harmonizing social, environmental and economic interests.

In order to contribute to sustainable development, a company should satisfy all ‘three pillars’ of sustainability: social, environment and economic. The dimensions are interrelated, that is, they influence each other in various ways. Based on the thinking in Willard’s model of stages of sustainability, organizations can have a reactive approach to this principle and try to ‘balance’ social, economic and environmental aspects by trading off the negative effects of doing business for a somewhat lower profit. For example, compensating CO2 emissions by planting new trees or

compensating unhealthy work pressure with higher salaries. A more proactive approach to sustainability looks at how organizations create a ‘harmony’ of social, environmental and economic aspects in their activities. This approach is not about compensating bad effects, but about creating good effects.

2. Sustainability is about both short-term and long-term orientation.

A sustainable company should consider both short-term and long-term consequences of their actions, and not only focus on short-term gains. Firms listed on the stock market may especially be tempted to focus on short-term gains, trying to increase performance from quarterly report to quarterly report, and thereby losing long-term vision. This principle focuses the attention to the full lifespan of the matter at hand. An important notion with regards to this principle is that the economical perspective, because of discounting of future cash flows, values short-term effects more than long-term effects. In economic theory, an immediate cash flow holds more value than a future cash flow, thereby emphasizing the value of short-term benefits. However, social impacts or environmental degradation because of business decisions, may not occur before the long-term.

3. Sustainability is about local and global orientation.

The increasing globalization of economies effects the geographical area that organizations influence. Intentionally or not, many organizations are influenced by international stakeholders whether these are competitors, suppliers or (potential) customers. The behavior and actions of organizations therefore have an effect on economic, social and environmental aspects, both locally and globally. ‘In order to efficiently address these nested and interlinked processes sustainable development has to be a coordinated effort playing out across several levels, ranging from the global to the regional and the local’ (Gareis et al. 2011).

4. Sustainability is about consuming income, not capital.

Sustainability implies that nature's ability to produce or generate resources or energy remains intact. This means that the source and sink functions of the environment should not be degraded. Therefore, the extraction of renewable resources should not exceed the rate at which they are renewed, and the absorptive capacity of the environment to assimilate waste should not be exceeded. (Gilbert et al. 1996). The economic equivalent of this principle is common knowledge in finance and business. Financial managers know that a company which does not use its income to pay for its costs, but instead uses its capital, will soon be insolvent. The principle may also be applied to the social perspectives. Organizations should also not 'deplete' people's ability to produce or generate labor or knowledge by physical or mental exhaustion. In order to be sustainable, companies have to manage not only their economic capital, but also their social and environmental capital.

5. Sustainability is about transparency and accountability.

The principle of transparency implies that an organization is open about its policies, decisions and actions, including the environmental and social effects of those actions and policies. This implies that organizations provide timely, clear and relevant information to their stakeholders so that the stakeholders can evaluate the organization's actions and can address potential issues with these actions. The principle of accountability is logically connected to this proactive stakeholder engagement. This principle implies that an organization is responsible for its policies, decisions and actions and the effect of them on environment and society. The principle also implies that an organization accepts this responsibility and is willing to be held accountable for these policies, decisions and actions.

6. Sustainability is about personal values and ethics.

A key element of sustainability is change: change towards more sustainable (business) practices. As argued by Robinson (2004) and Martens (2006), sustainable

development is inevitably a normative concept, reflecting values and ethical considerations of society. Part of the change needed for more a sustainable development will therefore also be the implicit or explicit set of values that individuals, business professionals or consumers have and that influence or lead behavior. GRI Deputy Director, Nelmara Arbex, puts it simple and clear: ‘In order to change the way we DO things, we need to change the way we VIEW things.’

Project Management

Projects have been around since ancient times, but project management is relatively new. It was not until the 1950’s that organizations began to apply standard tools to projects (Garel, 2013; Seymour & Hussein, 2014). Garel (2013) argued project management began in the second half of the twentieth century despite projects being around for thousands of years. Both Garel (2013) and Seymour and Hussein (2014) argued a project is different than project management. Seymour and Hussein (2014) attributes this difference to Henri Fayol and the five functions of management: planning, organizing, commanding, coordinating, and controlling and to Henry Gantt, the founder of the Gantt Chart. A Gantt Chart is a PM tool that breaks down projects into smaller tasks and visualizes the dependencies of one task to the next (Seymour & Hussein, 2014).

Although it should be expected that in ancient Egypt some form of project management was practiced in the construction of unique artefacts like the pyramids, it took until the 1950s to see the first developments of project management as a discipline (Turner et al. 2010). The most important forerunner of this development in the United States was Henry Gantt. From his study of the management of Navy ship building, he developed, early last century, a scheduling technique for projects that today is still considered an essential part of project management theory and practice: the Gantt chart or bar chart. The 1950s, however, brought the development of mathematical project scheduling models like the ‘Program Evaluation and Review

Technique' (PERT) and the 'Critical Path Method' (CPM). These techniques marked the take-off of project management as a discipline. Until the 1970s, the traditional fields of application of project management were construction, engineering and defense. Project management methods and theory were dominated by a 'hard' objective and scientific paradigm. In this 'hard' paradigm, the world is seen as an objective reality and 'systems are mechanistic processes, with stable, or predictably' outcomes (Crawford and Pollack 2004). This background may still be reflected in the definition of a project as 'a temporary endeavor undertaken to create a unique product, service or result' (Project Management Institute 2008).

However, with the emergence of information technology in later decennia, the applications of project management spread into all industries and contexts. And with this spread, the nature of project management changed. From a 'hard' mathematical technique to optimize planning, construction and production processes it developed into an instrument to manage organizational change (Gareis 2010). Therefore, a different, 'soft' paradigm to project management emerged in which projects evolve around social interaction rather than around mathematical optimization, and in which goals, methods, expectations, solutions, outcomes and success of projects are less manageable or predictable (Crawford and Pollack 2004). This change in paradigm is illustrated by a study of Kloppenborg and Opfer (2002) into the project management research published in English since 1960. An annotated bibliography was created of 3,554 articles, papers, dissertations and government research reports. The study identified a distinct shift in topics of interest over the decades. In the 1960s, most research focused on large, defense-related projects. In the 1970s, the research focused on cost and schedule control, performance measurement, work breakdown structures and life cycle management. While cost/ schedule control remained a topic of major research interest during the 1980s, research started to include team building, quality and knowledge management related topics. The 1990s saw a further increase

in Human Resource (HR) and organization-related topics such as organizational change, team development and leadership, as well as a focus on risk management. So, the nature of project management evolved from the application of mathematical techniques to the organization of structured processes and the management of organizational change. The ‘organizational change’ view on projects caused a need for further development of the project management profession. Traditional project management techniques and theory originated from systems management or cybernetics theory. With the scope of projects however, shifting from constructing or creating ‘things’ to organizational change, the complexity of the ‘system’ at hand increased.

In line with the development of projects and project management described above, this book views project management as the management of project-organized change in organizations, policies, products, services, processes, assets and/ or resources, in or between organizations. These project-organized changes, or simply projects, are characterized by:

- A temporary nature or temporary organization;
- Most often across organizational structures and boundaries;
- A defined deliverable or result, logically or preferably linked to the organization’s strategy or goals;
- Specified resources and budget.

In this definition, projects are, as temporary organizations, related to non-temporary ‘permanent’ organizations, and realize changes that benefit the strategy or goals of such organizations. The permanent organizations utilize resources and assets in their operational business processes to deliver products and/or services to their customers, creating benefits, and ultimately performance (for example, profit, market share, employment, return on capital and so on), to the organizations and their stakeholders.

Their activities are based on goals or ambitions that are developed or set in a strategic management process.

As mentioned according Mary McKinlay's keynote speech at the 2008 International Project Management Association (IPMA) World Congress Her vision that 'the further development of the project management profession requires project managers to take responsibility for sustainability' (McKinlay 2008) connects sustainability to the future of project management.

The concerns about sustainability indicate that the current way of producing, organizing, consuming and living may, or will, have negative effects on the future. In short, our current way of doing 'things' is not sustainable.

Therefore, 'things' (products, processes, materials, resources, our behavior), but also 'thoughts' (beliefs, values) need to change. Elaborating on the view of projects as instruments of change, it is evident that a (more) sustainable society requires projects to realize sustainable change. In fact, this connection between sustainability and projects was already established by the World Commission on Environment and Development (1987).

Project Management Methodologies

- **Waterfall:**

There are different approaches to traditional PM, one of which is Waterfall. The Waterfall approach to PM is an approach that follows a laid-out, step-by step method that works well for projects with many steps, few variables, and high predictability (Business Management Daily, 2021). The most common project variables are scope, time, and cost, but a project variable can be any input that can change after the project begins. Waterfall PM gets its name because each stage falls into the next without the ability to revise or go back (Novac & Ciochină, 2018)), just like a waterfall falling over a cliff.

Waterfall PM is a traditional approach to PM that is linear in nature and divided into fixed stages or phases. Waterfall PM requires all the work from the previous phase to be completed before proceeding to the next phase (Andrei et al., 2019). The common phases of Waterfall PM are Requirements, Design, Implementation (Coding), Verification (Testing), and Maintenance (Operations); the phases for software development phases are in parentheses (Andrei et al., 2019). Khoza and Marnewick (2020) stated Waterfall PM is a heavyweight, traditional PM method, and one of the most common approaches to PM. Waterfall PM is a management process that follows a detailed plan. According to Business Management Daily (2021) Waterfall PM is ideal for a project with multiple steps that are predictable in nature (Thummadi & Lyytinen, 2020). The steps in Waterfall PM can be easily copied from one phase to the next or one project to another. Andrei et al. (2019) proposed Waterfall PM can help a team organize better than other PM methods. Waterfall PM success is commonly judged in terms of on-time, within budget, and for the work, or scope, agreed. On-time, within budget, and in scope are commonly referred to as a triple constraint (Khoza & Marnewick, 2020). This is a typical method to measure success of projects. Thummadi and Lyytinen (2020) proposed Waterfall PM is more organized than other types of projects and operates with collocated customers providing an advantage over other types of projects. Thus, there are many advantages to Waterfall PM. While there are many advantages to Waterfall PM, there are also significant

shortcomings. Since Waterfall PM moves from one phase to the next once all the requirements and objectives of the phase have been achieved, it requires extensive upfront planning. Extensive upfront planning is also required to manage the project within the boundaries of the triple constraint (Andrei et al., 2019). In addition to the extensive upfront planning required, Waterfall PM requires a significant amount of documentation compared to other PM methodologies (Thummadi & Lyytinen,

2020). A potential drawback to Waterfall PM is, once the requirements are set, accepting changes can add significant cost and time to the original project plan (Andrei et al., 2019). Scope creep, or a change to project objectives beyond what was agreed at the start of the project, can cause delays, and add cost to the original development. Even though Waterfall PM is still a method organizational leaders rely on today, the challenges to adopt to rapidly changing business conditions, as evidenced by Andrei et al. (2019) and Khoza and Marnewick (2020), make it a less-than-ideal approach for many projects.

- **Stage-Gate PM:**

Another traditional approach to PM is stage-gate. Stage-gate PM method is a process of managing projects in stages, with a gate (i.e., decision point) between each stage. Gates are opportunities for go/kill decision points for management – in other words, whether to continue the project or stop the project. At each gate, management reviews a project's status and decides. Management decides if they should continue to fund a project (go) or stop funding a project (kill). Stage-gate is currently a very popular approach to managing new product development (NPD) projects. When undertaking new product development, defining the product or item the organization intends to use to produce value for the end user, and understanding the cost, occurs before large investment and big development activities kick-off (Cooper & Sommer, 2018). Because of the upfront investment and planning, if changes are necessary after this stage, it can be expensive for the organization. Another area stage-gate PM struggles is during the “fuzzy front-end” which is between idea creation and investment (Cooper & Sommer, 2019). The fuzzy front-end, considered a critical part of the development and innovation process, is where many key decisions occur (Cooper & Sommer, 2019). It is called “fuzzy front end” because at this stage it is not always clear what the product will look like, how it will work, the time required to develop it, or the cost involved. Companies wanted to find a method to manage

highly uncertain and highly ambiguous projects to minimize the impact of change after the work had begun. This need led them to adopt APM for NPD activities. Organizations adopt different PM methods for a variety of reasons, including organizational knowledge, capability, risk management, complexity of the project, adaptability, and costs. Common approaches to traditional PM are Waterfall PM and Stage-Gate PM. The matrix below compares Waterfall PM and Stage-Gate PM. Understanding how the PM approaches are different helps organizations to match the project to the PM approach most closely aligned with the project objectives. It became increasingly obvious that traditional PM approaches were not able to fully support the needs of organizations. For example, gaps in the Stage-Gate approach increased change costs and delayed the delivery of value (Cooper & Sommer, 2019). Also, the bureaucratic approach of Waterfall can drive-up costs (Andrei et al., 2019; Thummadi & Lyytinen, 2020). Issues like these are what caused people to try and find an approach to PM to focus on the product and meeting the customer expectations rather than maintaining the original plan. Additionally, they were seeking an approach to PM to allow teams to focus on developing the product, rather than focusing on documentation. Hence, introducing Agile and the rapid adoption across many industries and different size companies to address the concerns of change costs, bureaucracy, and inability to adapt to changing customer needs.

- **Agile Manifesto:**

The Agile Manifesto consists of the Four Key Values and twelve Guiding Principles. The primary intent of the key values is to explain what is important when following an Agile methodology to help with expectation setting and executive alignment. Zavyalova et al. (2020) proposed APM is a family of frameworks adhering to the principles laid out in the Agile Manifesto. Cooper and Sommer (2018) posited the Agile Manifesto guides APM and Agile product development, calling for a focus on collaboration, embracing change, and development of a working product. From its

beginnings in 2001, APM has progressed from an approach used only with software development to its usage in many industries and applications. Beck et al. (2001) published the Manifesto for Agile Software Development and said they wanted to find better ways to develop software by developing software and supporting others in developing software. Embracing a simpler approach to PM helped companies manage both software development activities and other PM activities.

Table 5. The Four Key Values of Agile Management - Adapted from Canty (2015)

Key Value	Description
Individuals and interactions over processes and tools.	Processes and tools help people do the work; therefore, people are more important than the tools and processes.
Working software over comprehensive documentation.	Tangible results of working software the customer can interact with is more important than documenting how the software was arrived at.
Customer collaboration over contract negotiation.	Working with the customer and being flexible to the customer needs is more valuable than negotiating detailed contracts.
Responding to change over following a plan.	Agile embraces change, even late in the project; therefore, being open to change is more important than following a strict project plan.

The second part of the Agile Manifesto is the 12 guiding principles. The four key values plus the 12 guiding principles combine to create the Agile Manifesto (Canty, 2015; Vidoni et al., 2020). The guiding principles of Agile provide guidance for Product Owners, Scrum Master, and the development teams working on Agile projects (Cooper & Sommer, 2018). These principles help the Agile team focus on what is important, such as face-to-face communication, accepting change, simplicity, and developing a working product without unnecessary function (Canty, 2015).

The Agile approach to PM helps to provide flexibility to organizations and projects. The APM method is a new way to think about PM (Garcia & Russo, 2019).

- **Lean Management:**

Nowadays, companies in the service sector use “Lean Management” to improve operational excellence, enhance continuous improvement and reduce processes waste. [Alalawin et al., (2022)]. Lean management is one of the key concepts that help organizations to maintain competitiveness and gain leverage in their business field. It is defined as an optimization methodology that focuses on reducing cost and cycle time by eliminating the seven known kinds of wastes via scientific ways to determine what is important in terms of exceeding the common thinking patterns to improve the performance and efficiency of a process in any system (Ante et al., 2018; Goshime et al., 2019; Prado- Prado et al., 2020). Implementing and adopting the philosophy and the tools of manufacturing in all sectors not just the industrial one is called lean management (Bednarek et al., 2020).

According to Sujata et al. (2015), another challenge was that the telecom companies, especially the cellular and telephone companies, were facing the beginning of Over the Top service providers. Due to the global competition in the telecom industry nowadays, companies need to provide a high-quality service to its customers to stay at the top of this competition. Lee (2013) suggested that the telecom companies need to provide high-quality services to its customers to compete globally. In general, customers’ satisfaction can increase when a high-quality service is provided and, as a result, customers can become loyal to the service providers. Therefore, effective customer service always leads to a customer satisfaction (Khan & Afsheen, 2012). For telecom companies providing a high-quality service, quality management, one of the most critical management strategies, has to be included. Lean management is one of the quality management tools which provide better results by continuous improvement and waste reduction (Chiarini, 2013).

According to Narvekar (2018) telecom companies waste almost 30% of the process-related costs. A lean approach can help these companies to reduce waste. Their

research suggested that the telecom companies may become unable to compete if they do not implement lean in their processes and departments. Lately, Abu Salim et al. (2018); Salim et al. (2018) identified the reality of the lean management in Jawwal Company from the point of view of its employees. Also, they identified creativity levels of the workers in Jawwal in many dimensions such as problem solving, acceptance of risks, decision making, changeability, and encouragement of creativity. Msallam et al. (2019) identified the extent of the technical colleges' commitment to the application of the lean management. Shams uzzaman et al. (2018) implemented lean in the telecommunication sector to improve the order fulfillment process. In their study, they reduced the fulfillment process time by more than 40%. Sinha et al. (2020) utilized the internal and external customers' feedback to improve the service quality in the telecommunication sector, where AP et al. (2020) investigated the effect of lean management on the overall improvement of the telecommunication sector in Nigeria. Lestari and Dachyar (2020) presented a case for Indonesia to incorporate lean in quality function deployment in the telecommunication sector. Selvaraju et al. (2019) investigated the critical success factors of Lean Six Sigma and their effects on the performance of the telecommunication supply chain. A green lean for a public sector, where telecommunication sector is considered as one of the public sectors, is developed by Sandhya and Raju (2018).

- **Lean + Agile = LeAgile:**

Historically, competitiveness in the manufacturing industry was found in internal efficiencies, but improving efficiencies is no longer sufficient to maintain competitiveness. Moyano-Fuentes et al. (2018) argued that to maintain competitiveness, organizations needed to develop supply chain management approaches to support competitiveness through the entire supply chain. Agile supply chain is a business strategy to help organizations be ready for and respond to change rapidly and efficiently (Shashi et al., 2020). Competitive supply chains have the

minimal amount of material in process to meet the customer demands. This requires organizations to manage the supply chain all the way from the point where the customer places an order to the raw material suppliers. This type of management and coordination is extremely challenging which led to the introduction of Lean PM. Lean PM needs to address the entire supply chain, manufacturing processes, and distribution of the product from the point of raw material until a finished product is in the hands of the customer (de Oliveira Santos & de Carvalho, 2020). While lean is not the same as Agile, there are similarities between the two approaches; however, there are enough differences that Wang et al. (2012) coined the phrase “leAgile” to explain the combination of lean and Agile principles.

Lean and Agile are not synonymous; however, when combined, they are highly effective. According to de Oliveira Santos and de Carvalho (2020), agile focuses on adaptability, and lean focuses on adding value. Lean traces its roots to the Toyota Production System (TPS) which focuses on eliminating wastes, creating value, and zero interruptions (de Oliveira Santos & de Carvalho, 2020). According to Liker (2004), TPS is built on the four “Ps” of philosophy, process, people, and problem solving and these are what create the sustainability of TPS and are the building blocks for lean. Harada (2015) proposed a shorter supply chain to move the supply chain closer to the process to allow an organization to have more control if a problem occurs. Lean supply chains can respond as one to changes in the environment to meet the needs of customers (Moyano Fuentes et al., 2018). The focus of lean is to cut waste and to create sustainable value, whereas Agile focuses on embracing and responding to change and empowering people doing the work to decide how to do the work. APM complements lean manufacturing by focusing on how to embrace and respond to change. Agile techniques focus on self-management, short iterations (de Oliveira Santos & de Carvalho, 2020), and accepting change. Unlike lean supply chains, which focus on responding as one and eliminating waste, an Agile supply

chain focuses on responding to demand quickly and being sensitive to the market (Moyano-Fuentes et al., 2018). Agile encourages stronger communication and the creation of a working product at the end of each iteration (Cvetkovic et al., 2017). Combining Agile and lean, or “leAgile,” is an effective strategy companies use to introduce flexibility and responsiveness into their supply chain, allowing them to capture the best of both worlds. LeAgile is not for every organization or every situation. Lean supply chains are 54 best suited for competitive environments with insufficient assets and Agile supply chains are better suited for changing markets (Galankashi & Helmi, 2016; Rashad & Nedelko, 2020) and a leAgile supply chain attempted to balance responsiveness and effectiveness (Rashad & Nedelko, 2020). Supply chain strategies are not mutually exclusive, and organizations can use a pure strategy, such as lean or Agile, or a hybrid strategy like LeAgile, or all three depending on the situation (Fadaki et al., 2019). Fadaki et al. (2019) argued based on previous studies hybrid strategies outperform pure strategies, which is something organizations would need to consider when evaluating and deciding on a strategy. Organizational supply chain strategies should not be limited to one size fits all or even one type for all. In fact, organizations are free to choose the best strategy for their situation and needs. Organizations should decide on their supply chain based on the goods they are providing and the markets where they compete. The idea behind any supply chain is to deliver the right product, at the right price, at the right time (Mason-Jones et al., 2000), to the right place, in the right way. A supply chain is the lifeblood of the organization and failure to do the above will cause organizational failure. An advantage of a leAgile supply chain is the ability to meet the volatile customer demand and changes in production to meet the demand (Galankashi & Helmi, 2016) and deliver the right product, at the right price, at the right time, to the right place, and in the right way. There is a tradeoff between lean and Agile regarding lead time and cost and if there is a reduction in lead time, the

cost increases and vice versa; therefore, organizations need to find the balance between lead time and cost (Rashad & Nedelko, 2020).

- **Six Sigma Methodology:**

Quality management has been an extremely important management strategy for achieving competitive advantages and improvements. Traditional quality concepts like Statistical Quality Control, Statistical Process Control, Zero Defects and Total Quality Management, have been major key players for many years; While Six Sigma is a more recent initiative quality improvement to gain popularity and acceptance in many industries as well as service industries across the world.

In many organizations and industries, Six Sigma means a business management process that provides important and tangible business results to the bottom line by the continuous process improvement and variation reduction. As a data-driven, by the statistically-based approach, Six Sigma aims to deliver near zero defects for every product, process, and transaction within an organization.

The basic elements of Six Sigma like Statistical Process Control, Failure Mode Effect Analysis, Gage Repeatability and Reproducibility and there are other tools that have been on reduction of rejects and enhancing the quality. Six Sigma provides a basic framework in which all these tools can be performed with management support .

Though Six Sigma was originally developed for manufacturing processes, but today service firms and service functions within almost every sector and also used by some service industries like telecom, hospitals etc. are mainly using Six Sigma to improve profits and performance. They are using Six Sigma in their marketing, finance, information systems, legal, and human resources processes in order to solve the major problems. So, Six Sigma methodology has a major role to play under these circumstances to pinpoint the major problem areas and devise powerful strategies to tackle and such problems which improve the customer experience.

Six Sigma methodology and major statistical methods ensure the throughout improvement in quality and reduction in rejects with the definition of targets and visions. Implementation of Six Sigma will be achieved through a series of successful projects in service industries. Transactional Business Process Project: an improvement of a transactional business process that extends across an organization; such as order processing, inventory control and customer services.

Developing the Methodology in Telecom Industries

We executed and implemented DMAIC, the five phase process improvement methodology of Six Sigma, to meet the objectives set for the quality in telecom company improvement project: Phase 1: Define opportunities, Phase 2: Measure performance, Phase 3: Analyze factors impacting performance, Phase 4: Improve performance, and Phase 5: Control performance.

A. Phase 1- Define Opportunities:

The Define phase is to make clear understanding of scope and objective to publish project charter and problems; All relevance stakeholders have been understood. Also, the organization's purpose and scope will be defined during the phase. One of the key major success factors of Six Sigma is that it starts with an understanding of what service processes are critical to telecom industries in achieving these objectives. These are also called the critical to quality (CTQ). This has a structured approach and with clarity as far as the phase goals, tasks, deliverables, and techniques are concerned. Understanding the cost-of-service delivery process is an important index and tool that makes us to evaluate the process based on and scoring the mentioned process. Also, identifying the problems and defining the measurable objectives and results are the most important objectives of this phase. The most desired result is to set a definitive vision, scope, and strategic approach for quality improvement operations. Six deliverables has been produced in the Define phase:

1. Project charter and planning;

2. Data collection;
3. Stakeholder analysis and evaluation;
4. Critical to Quality (CTQ) outline in telecom industries;
5. Cost of poor quality and improvement;
6. Overall overview of the process to be improved.

B. Phase 2 - Measure Performance:

Measure performance phase focused on the distribution, anthology, and refinement of telecom industries. Planning for collection of the different measurements has been done in the Measure phase. It defines the imperfections of quality measurements, evaluate the "as is" process, and create a current-state assessment of the current service delivery. This phase will help the organization rank the potential causes of quality improvement, which would be useful in investigation through benchmarking the current process performance. This phase creates four deliverables as follows:

1. Process capability and performance;
2. Critical input and proves variables that can affect output quality;
3. Service delivery defects;
4. Critical Success Factors (CTQ) summary chart.

C. Phase 3 -Analyze Factors Impacting Performance:

The Measure phase produces the baseline performance of the service delivery processes. Indeed, in this phase the collected data in the Measure phase have been examined to generate a high ranking list of the sources of variation in telecom industry and identify the root cause of problems. Eight deliverables has been formed in the Analyze phase:

1. Cause and Effect Diagram of problems

2. Frequency plots and graphs
3. Data and information flow diagram
4. Affinity diagram
5. Critical Success Factors (CTQs) benchmarked to identify opportunities for improvement;
6. Regression analysis of data.
7. Scatter plots and diagrams
8. Threats and opportunities.

D. Phase 4 - Improve Performance

The aim of improve performance phase is to identify some options for solutions which can be useful for the identified problems during analysis phase. So, the alternative policies could be rank and select for future improvement. Recommendation and implementation of the solutions are the most important objectives of this phase. In this phase mainly five deliverables has been produced:

1. Data and information flow diagram;
2. Risk Assessment;
3. Design of different experiments
4. Ranking different solutions;
5. Improvement planning for quality improvements.

E. Phase 5- Control Performance:

The problem has been assessed and an improvement process put in place, putting a solution in place can fix problems for the moment, but the work in phase 5 is designed to ensure the problem stays fixed and secure. Also, the obtained knowledge in the improvement project can be consulted in other areas to help accelerate improvements of service delivery. Six deliverables would be obtained in this phase:

1. Control charts for quality improvement

2. Quality control process charts
3. Standardization charts for quality
4. Process metrics defined and implemented in telecom sector
5. Control Plan implemented
6. Risk mitigation actions complete and implemented. [Khandelwal, Madhav and Khandelwal, Neha (2013)].

Research Methodology

The study employs a mixed-method approach to encompass both the quantitative breadth and qualitative depth necessary for a comprehensive analysis. In terms of quantitative analysis, the research employs survey data to evaluate the prevalence and efficacy of diverse project management strategies across major telecom entities, including the Public Telecommunication Corporation, Sabafon, YOU Telecom, Tele Yemen, and Yemen Mobile, the quantitative component of the study was analyzed using SPSS software. Reliability testing was conducted using Cronbach's Alpha to assess the reliability of the survey instrument, ensuring internal consistency among items related to the same construct. In terms of qualitative analysis, the research deepens through the use of in-depth interviews and case studies to examine the experiential and contextual factors influencing the adoption and effectiveness of project management strategies.

The statistical tools employed in this study include analyses such as frequencies and percentages, calculating the mean and standard deviation, as well as stability and reliability tests such as Cronbach's alpha. The chi-squared test is also employed to examine the statistical relationships between nominal variables. This quantitative analysis enables the estimation of the impact of contemporary project management methodologies on sustainable development goals and the effectiveness of these methodologies in improving organizational performance and overall efficiency. The researcher conducted a preliminary test on a specific sample from the study

population using Cronbach's Alpha to derive the reliability coefficient and calculate its value. The tool was applied to a sample of 15 telecommunications workers, representing 10% of the total study sample, with a 15-day interval between the two tests. The reliability was found to be high (0.88), which confirms confidence in the responses of the study participants.

Results Discussion:

Outlines the Characteristics and Features of the Study Sample:

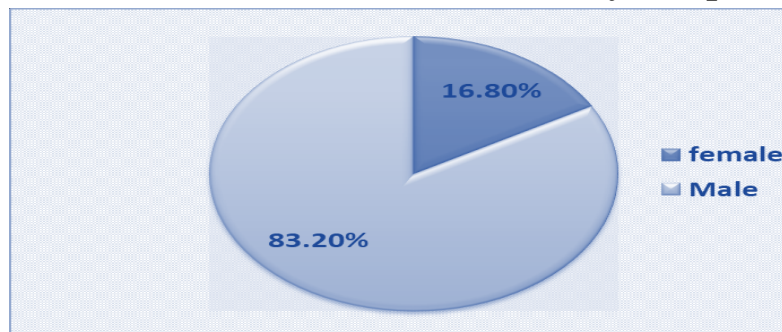


Figure1. the study sample by gender

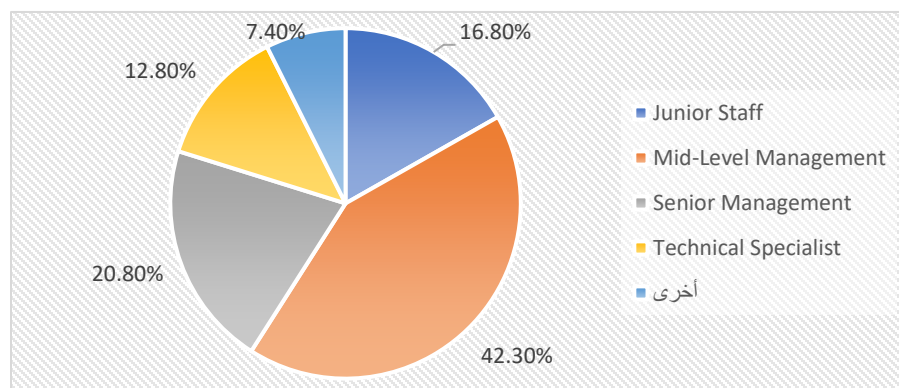


Figure2. Shows the percentage of the study sample by job position

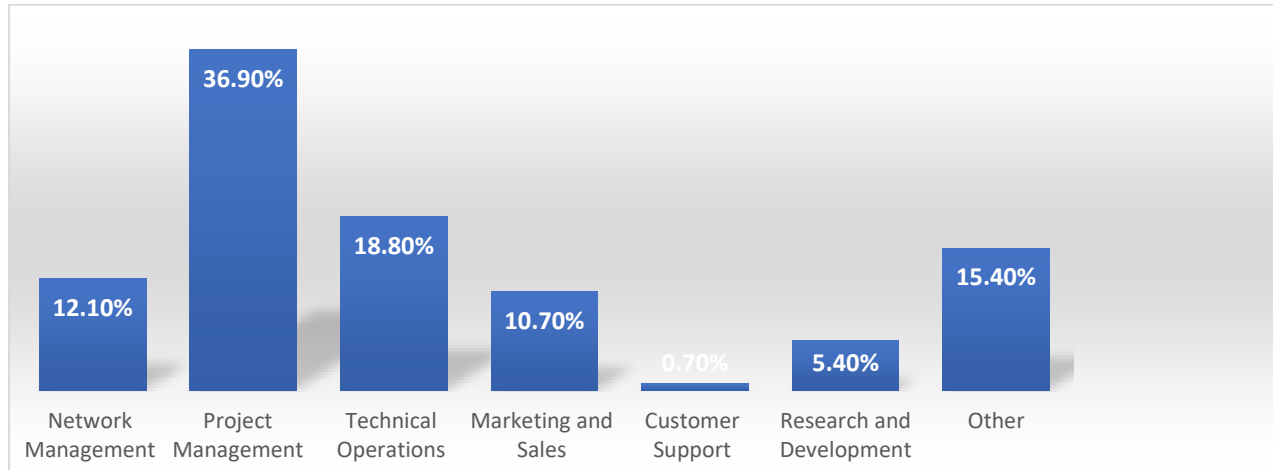


Figure3. illustrates the distribution of areas of responsibility for the study sample in the telecommunications sector.

Results Discussion

- According the first question: What are the current project management methodologies used in the telecommunications sector in Yemen?

The responses were as follows:

Table 6. illustrates the study sample's knowledge of modern methodologies

Answer	Count	Percentage
Agree	79	53.0%
Disagree	70	47.0%
Total	149	100%

The results of the previous Table (6) indicate that 53.0% of the study sample from employees in the telecommunications sector have a broad knowledge of modern methodologies, whereas 47.0% of them responded that they do not have knowledge of modern methodologies, as illustrated in the figure (4).

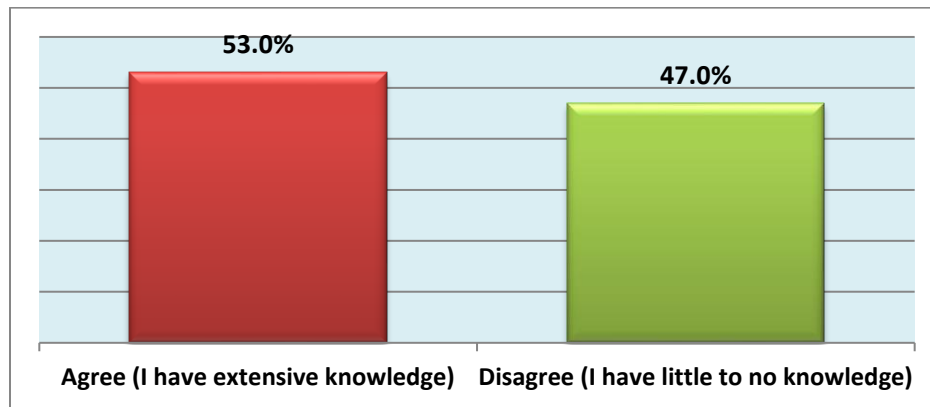


Figure. 4. shows the study sample's knowledge of modern methodologies

Table (7) Project Management Methodologies Currently Used in the Telecom sector

Methodology	Count	%
Agile	34	22.8
Scrum	9	6.0
Lean	1	0.7
Six Sigma	15	10.1
Waterfall	62	41.6
Other	28	18.8
Total	149	100

The results of the previous table (7) show that Waterfall is the leading methodology currently used in project management within the institution, accounting for 41.6%. Agile follows with 22.8%, then other methodologies at 18.8%, Six Sigma at 10.1%, Scrum at 6.0%, and Lean at a low rate of 0.7%, as illustrated in figure (5).

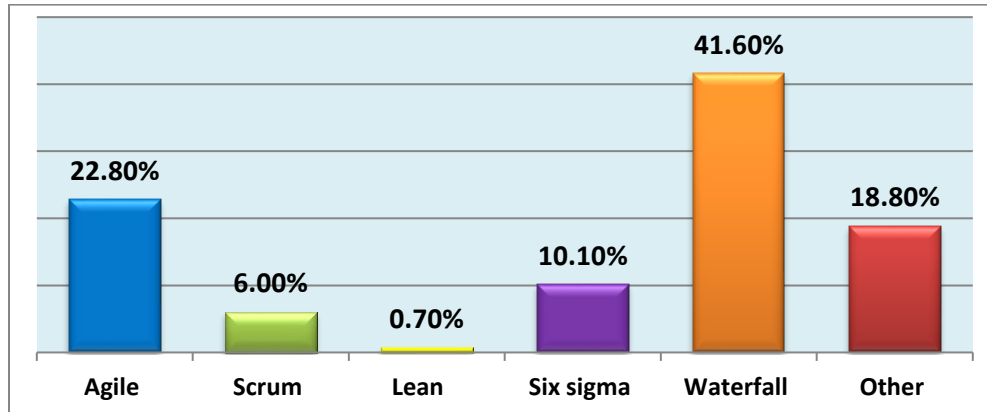


Figure 5.

Table (8) Extent of Formal Training in Project Management Methodologies Received by the Study Sample in the Telecommunications Sector

Response	Count	%
Agree	29	19.5
Agree to some extent	75	50.3
Disagree	45	30.2
Total	149	100

The results of the previous table (8) regarding the extent to which the study sample has received formal training in project management methodologies show that 19.5% of the respondents agree they have received comprehensive training, while 50.3% agree to some extent, indicating they have received partial training. Meanwhile, 30.2% disagree, indicating they have not received any formal training in project management methodologies.

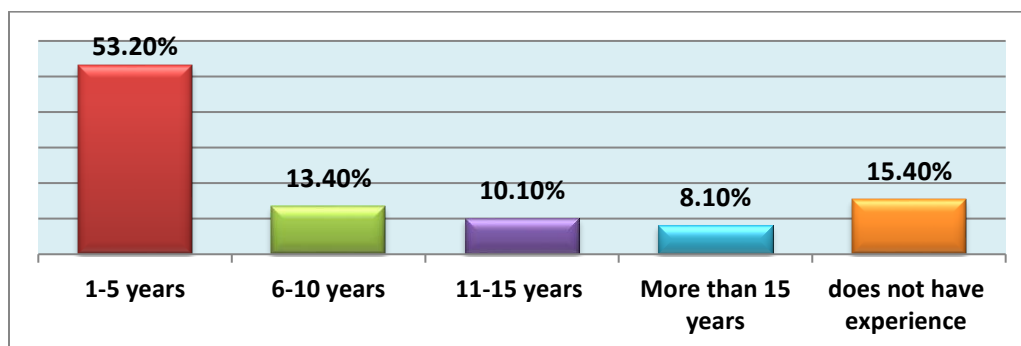


Figure (6) shows the experience of the study sample in using project management methodologies

Figure 6. illustrates the experience levels within the study sample regarding the use of project management methodologies. The largest proportion, comprising 53.0% of the sample, has experience ranging from 1 to 5 years. Following this, 15.4% of the participants have no experience in using project management methodologies. Those with experience ranging from 6 to 10 years account for 13.4%, those from 11 to 15 years constitute 10.1%, and those with over 15 years of experience make up the smallest group at 8.1%.

- The second question concerns about the obstacles must be overcome to achieve sustainable results using these methodologies.

Table 9: Extent of Regular Integration of Sustainability Considerations into Decision-Making Process by the Study Sample

Level of Agreement	Count	Percentage
Always	14	9.4%
Often	56	37.6%
Sometimes	30	20.1%
Rarely	31	20.8%
Never	18	12.1%
Total	149	100%

Results from Table (9), show how frequently the study sample incorporates sustainability considerations into their decision-making processes. 9.4% of respondents always integrate sustainability, indicating a deep commitment among a small group of participants. 37.6% do so often.

Table (10): Extent of Dedicated Budget Availability for Implementing Sustainable Practices in Study Sample's Projects

Response	Count	Percentage
Agree	38	25.5%
Agree to some extent	62	41.6%
Disagree	49	32.9%
Total	149	100%

The results from Table (10) reveal the extent to which there is a dedicated budget for implementing sustainable practices in the projects of the study sample. 25.5% of the respondents agree that there is a clearly dedicated budget, indicating an explicit financial commitment and a willingness to support sustainability through financial resources. 41.6% agree to some extent.

Table (11): Extent of Agreement among Study Sample on the Contribution of Implemented Methodologies to Project Success in Their Organizations

Level of Agreement	Count	Percentage
Strongly Agree	19	12.8%
Agree	85	57.0%
Neutral	34	22.8%
Disagree	10	6.7%
Strongly Disagree	1	0.7%
Total	149	100%

The results of Table (11), reflect the study sample's degree of agreement regarding whether the methodologies used in their organizations contribute to project success.

12.8% strongly agree, and 57.0% agree, indicating a majority (69.8%) believe these methodologies effectively contribute to project success.

Table (12): Extent to Which Project Management Methodologies Incorporate Sustainability Practices in the Organization

Response	Count	Percentage
Widely	40	26.8%
To Some Extent	88	59.1%
Not at All	21	14.1%
Total	149	100%

The results of Table (12) show how project management methodologies used within participating organizations incorporate sustainability practices. 26.8% of participants indicate that sustainability is widely incorporated, 59.1% say it is somewhat incorporated, and 14.1% report no incorporation of sustainability practices.

Table (13): The main challenges in implementing sustainability in the communications projects of the study sample

Challenge	Extremely Difficult	Significant Challenge	Moderate Challenge	Slight Challenge	Not a Challenge at All	Average Score	Relative Weight
Cost Constraints	11 (7.4%)	74 (49.7%)	34 (22.8%)	19 (12.8%)	11 (7.4%)	3.36	67.2%
Lack of Knowledge	16 (10.7%)	80 (53.7%)	30 (20.1%)	16 (10.7%)	7 (4.7%)	3.55	71.0%
Technological Limitations	14 (9.4%)	65 (43.6%)	34 (22.8%)	27 (18.1%)	9 (6.0%)	3.32	66.4%
Regulatory Issues	13 (8.7%)	71 (47.7%)	39 (26.2%)	21 (14.1%)	5 (3.4%)	3.44	68.8%
Availability of Sustainable Resources	19 (12.8%)	63 (42.3%)	39 (26.2%)	19 (12.8%)	9 (6.0%)	3.42	68.4%
Stakeholder Engagement and Support	12 (8.1%)	59 (39.6%)	43 (28.9%)	28 (18.8%)	7 (4.7%)	3.27	65.4%
Total Responses	149	149	149	149	149		

Key insights from the table:

Lack of Knowledge is considered the most significant challenge, as indicated by the highest relative weight of 71.0%.

Regulatory Issues and Availability of Sustainable Resources also pose substantial challenges, highlighting areas where bureaucratic barriers and resource constraints inhibit sustainability efforts.

Cost Constraints and Technological Limitations are also notable challenges, with relative weights indicating that financial and technological barriers are significant concerns in implementing sustainable practices.

Stakeholder Engagement and Support received the lowest relative weight, suggesting that while it is a challenge, it is less critical compared to others listed.

This table provides a comprehensive view of the hurdles faced by telecommunications projects concerning sustainability, indicating the importance of addressing these challenges to achieve effective and sustainable project implementation.

Table (13), presents the main challenges in implementing sustainability in telecommunications projects according to the study sample. The relative weight and arithmetic mean provide a measurement of the importance and impact of each challenge from the sample's perspective.

Table (14), The extent to which telecommunications organizations possess a clear policy on sustainability in project management

Response	Count	%
Agree	26	17.4
Agree to some extent	74	49.7
Disagree	49	32.9
Total	149	100

The results of the previous table (14), reveal the extent to which telecommunications organizations possess a clear policy on sustainability in project management. 17.4% of respondents confirmed having a clear policy, 49.7% agreed to some extent, while 32.9% of the study sample disagreed.

The results of the table provide insights into the adoption of sustainability policies in project management by telecommunications organizations.

Table (15) Importance of Improvements for Current Project Management Methodologies in Telecommunications Companies

Improvement Area	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Average Score	Relative Weight
Training and Skill Development	49 (32.9%)	83 (55.7%)	9 (6.0%)	4 (2.8%)	4 (2.7%)	4.13	82.6%
Increased Focus on Data Analysis	38 (25.5%)	95 (63.8%)	12 (8.1%)	4 (2.7%)	-	4.12	82.4%
Enhancing Communication and Collaboration	30 (20.1%)	102 (68.5%)	10 (6.7%)	6 (4.0%)	1 (0.7%)	4.03	80.6%
Integrating International Best Practices	39 (26.2%)	88 (59.1%)	11 (7.4%)	8 (5.4%)	3 (2.0%)	4.02	80.4%
Implementing Principles of Sustainable Development	25 (16.8%)	99 (66.4%)	17 (11.4%)	5 (3.4%)	3 (2.0%)	3.92	78.4%
Effective Use of Technology	41 (27.5%)	93 (62.4%)	8 (5.4%)	5 (3.4%)	2 (1.3%)	4.11	82.2%

Table (16): Clarity of Roles and Responsibilities Related to Sustainability in Telecommunications Companies

Response	Yes (13.4%)	Neutral (47.7%)	No (38.9%)
Details	A small percentage of respondents affirm that there is clear definition and understanding of sustainability roles and responsibilities in their companies.	A significant portion of the sample does not have a definitive stance, indicating a potential lack of information or uncertainty about the implementation and application of sustainability policies and practices.	A considerable percentage indicates a lack of clarity in roles, highlighting a significant gap in communication and organization concerning sustainability within companies.

Table (17): Extent of Sustainability Practices in Telecommunication Companies

Response	Yes (11.4%)	To Some Extent (68.5%)	No (20.1%)
Details	A small percentage of participants acknowledge the full adoption of sustainability practices in their organizations.	A significant majority indicate that their organizations adopt sustainability practices to some extent, but not fully or consistently.	A considerable percentage of participants report the absence of sustainability practices in their organizations.

Table 18: Extent to Which Telecommunication Companies Have Set Specific Sustainability Goals for Projects

Response	Agree (10.7%)	Agree to Some Extent (51.7%)	Disagree (37.6%)
Details	A small percentage of participants confirm that their organizations have set specific sustainability goals.	A majority indicates some level of goal setting but suggests that these are not well-defined or consistently enforced.	A substantial number state that their organizations do not have clear sustainability goals.

Table (19): Extent to Which Individuals are Specifically Responsible for Sustainability in Telecommunication Companies

Response	Agree (14.1%)	Agree to Some Extent (39.6%)	Disagree (46.3%)
Details	A small percentage of respondents confirm that there are designated individuals responsible for sustainability.	A significant portion acknowledges some level of responsibility but suggests it may be informal or insufficient.	A large majority indicates no designated individuals, pointing to a systemic lack of focus on sustainability.

Table (20): Extent of Sustainability Training Provision for Employees in Telecommunication Companies

Response	Frequency	Percent	Valid Percent
Disagree	73	49.0	49.0
Agree to Some Extent	61	40.9	40.9
Agree	15	10.1	10.1
Total	149	100.0	100.0

The research indicates that a variety of project management methodologies are recognized within the telecommunications sector in Yemen, although the depth of understanding and implementation varies:

Modern Methodologies: Some awareness of modern methodologies such as Agile, Lean, and Six Sigma exists among participants, but their application is not widespread. Only about one-third of respondents have clear strategies for adopting these methodologies, while over half are considering it.

Traditional Approaches: Many respondents still rely on traditional project management approaches, with only a limited number adopting modern methodologies comprehensively.

Partial Integration: Where modern methodologies are used, they are often not fully integrated into the operational frameworks, with only 11.4% of respondents adopting sustainable practices fully.

Several obstacles hinder the achievement of sustainable results in the telecommunications sector when using these project management methodologies:

Lack of Awareness and Commitment to Sustainability: While there is some recognition of sustainability's importance, there is a lack of deep awareness and full commitment. Only 78.4% of respondents show agreement with implementing sustainable development principles, reflecting a significant gap in the sector's commitment to sustainability.

Insufficient Training and Development: Training on sustainability is not comprehensively provided, with only 10.1% agreeing that such training is available. This limits employees' ability to implement sustainable practices effectively.

Undefined Roles and Responsibilities: Clarity regarding roles and responsibilities related to sustainability is lacking, with 38.9% of respondents reporting that these are not clearly defined. This ambiguity can lead to accountability issues and inefficiencies in implementing sustainability initiatives.

Weak Accountability Systems: The absence of robust accountability systems is a significant barrier, with 57% of respondents stating that no clear system exists. Without strong accountability, long-term sustainability initiatives are challenging to maintain and evaluate effectively.

Partial Implementation of Sustainable Practices: The partial implementation of sustainability practices, where only 11.4% of respondents fully adopt them, indicates that sustainability is not yet integrated into the operational frameworks of most companies.

Documentation and Accessibility of Sustainability Practices: There is a gap in the documentation and accessibility of sustainability practices, with 44.3% noting that practices are not well-documented or accessible. Proper documentation is essential for transparency and the dissemination of best practices within the organization.

Regulatory Issues and Resource Availability: Additional challenges include regulatory issues, the availability of sustainable resources, cost constraints, and technological limitations. These factors further complicate the adoption and success of sustainable practices.

To overcome these obstacles and achieve sustainable results, strategic actions focusing on enhanced sustainability education, clear role definitions, robust accountability, integration of global best practices, and improved documentation are recommended. These steps would align Yemen's telecommunications sector with global sustainability standards.

Recommendations:

1. Enhance sustainability training programs to raise awareness and build capabilities.
2. Clearly define sustainability roles and improve accountability systems to ensure consistent implementation.
3. Adopt international sustainability standards and share global best practices.
4. Fully implement sustainable practices using regular evaluation and feedback to refine approaches.
5. Improve documentation of sustainability work and ensure materials are accessible to all employees.

By addressing challenges like lack of knowledge and skills, unclear responsibilities, and limited implementation, the sector can better align with global sustainability

norms. Comprehensive training, clear directives, full practice integration, and knowledge-sharing can help overcome barriers to adoption.

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