

KEY MAJOR BARRIERS AFFECTING THE ADOPTION STAGES OF 6-SIGMA WITHIN LIBYAN TELECOMMUNICATIONS SECTOR (A CASE STUDY)

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المخلص

تهدف هذه الدراسة إلى تقييم أهم العوائق الرئيسية التي تعترض تبني منهجية 6 سيجما في قطاع الاتصالات في ليبيا. وتعتبر 6 سيجما منهجية معترف بها دوليًا، تُستخدم لتعزيز الجودة وتقليل نسبة الأخطاء، من خلال توفير إطار منظم لتحسين العمليات داخل المؤسسات؛ وضمان كفاءة العمليات وفعاليتها. اعتمدت الدراسة على منهج استكشافي تدريجي، تضمن استبيانات منظمة ومقابلات متعمقة مع عدد من المتخصصين والخبراء في المجال. وقد سمح هذا التصميم بجمع البيانات الكمية والنوعية لتحديد أبرز العقبات التي تعيق التنفيذ الفعال. كشفت نتائج الدراسة أن من أهم العقبات: المقاومة الداخلية للتغيير، الانطباع العام حول تعقيد المنهجية، وافتقارها للتوافق مع المعايير الدولية، بالإضافة إلى تحديات إدارة البيانات وضعف الفعالية الاستراتيجية. كما أكدت الدراسة على أهمية دور الإدارة العليا وقادة المشاريع في تعزيز التغيير وترسيخ ثقافة الجودة داخل المؤسسات. استنادًا إلى النتائج المستخلصة، توصي الدراسة بتبني استراتيجيات شاملة لإدارة التغيير، تتضمن برامج تدريبية مصممة بعناية وحملات توعوية تهدف إلى تسهيل فهم مفاهيم 6 سيجما. كما تدعو إلى صقل ممارسات إدارة البيانات، ووضع معايير إقليمية تتناغم مع المعايير الدولية، لضمان تنفيذ منهجية مستدامة وناجحة. من خلال تطبيق هذه التوصيات، يمكن لمؤسسات قطاع الاتصالات الليبي أن تحسن بيئة العمل بشكل فعال ومستدام، مما يسهم في تعزيز قدرتها التنافسية.

الكلمات الرئيسية: 6-سيجما، الاستخدامات، المعوقات، ليبيا، قطاع الاتصالات.

ABSTRACT

This study aims to evaluate the key barriers hindering the adoption stages of 6-Sigma within the Libyan telecommunications' sector. 6-Sigma is recognized globally as a structured approach for enhancing quality and minimizing defects, and provides organizations with a systematic framework for process improvements, and ensuring the operational efficiency and effectiveness. The study adopts a sequential exploratory research approach, incorporating a structured questionnaire and in-depth interviews with the targeted professionals and experts within the selected industry. The findings reveal that the most prominent barriers include internal resistance to change, the perceived complexity of 6-Sigma, misalignment with international standards, challenges in data management, and a lack of strategic effectiveness. Additionally, the study underscores the crucial role of top management and project leaders in driving change and fostering a culture of quality within telecommunications' sector. Based on the findings, the study recommends implementing comprehensive change management strategies, including

customized training programs and awareness campaigns to simplify 6-Sigma concepts. Furthermore, it advocates for enhancing data management practices and establishing regional standards aligned with international benchmarks to ensure successful and sustainable adoption of 6-Sigma. Thereby, the Libyan telecommunications sector can create a more efficient and sustainable work environment, ultimately improving the competitive performance levels throughout the entire Libyan telecommunications' sector.

KEYWORDS: 6-Sigma, Application, Barriers, Libya, Telecommunications' Sector.

INTRODUCTION

In recent years, telecommunications' sector has made significant strides, marked by integrating cutting-edge technologies and expanding essential and desired services. Libya, in particular, has established a robust telecommunications infrastructure, providing nationwide mobile network and internet coverage. Libyan telecommunications companies offer a comprehensive suite of services, including voice calls, messaging, mobile internet, and broadband access. Recognizing the need for continuous improvement, these companies actively seek to enhance the quality of their administrative and technical operations, which necessitates the adoption of up-to-date tools and techniques.

Given the significance of 6-Sigma in the telecommunications' sector, this paper explores key barriers that hinder its adoption among Libyan telecommunications' companies. The objective is to provide actionable recommendations that address the most significant challenges associated with implementing this methodology within the targeted sector in the country. In this context, the main objective of this study is to evaluate the key barriers affecting the implementation stages of the Six Sigma methodology within the Libyan telecommunications sector. Specifically, the study seeks to identify the most critical barriers, understand their underlying causes, and propose actionable recommendations to facilitate the successful and sustainable adoption of Six Sigma practices across the sector.

AN OVERVIEW OF 6-SIGMA

6-Sigma (6σ) is a prominent quality and processes improvement methodology that originated in 1986 with Motorola. It gained recognition when Jack Welch adopted it at General Electric in 1995, and nowadays it has become widely adopted across various industries worldwide [1]. The objective of 6-Sigma is to achieve near-zero defects in products and services, reaching an accuracy of 99.99966%, or 3.4 defects per million opportunities. It follows a structured process to define, measure, analyze, improve, and control processes to ensure high-quality outcomes. To reach this goal, a range of quality management methods, including statistical techniques, are used to develop a skilled workforce, which includes Black Belts, Green Belts, and Yellow Belts. Each 6-Sigma project follows a defined sequence and aims to achieve measurable objectives, such as reducing cycle time, minimizing waste, lowering costs, increasing profits, enhancing customer satisfaction, and improving quality levels [2].

The 6-Sigma methodology consists of five phases: Define, Measure, Analyse, Improve, and Control (DMAIC), which are designed to identify and eliminate defects in processes, products, and services. The process begins with defining the problem and concludes with controlling the improved process to sustain gains. 6-Sigma is a data-driven methodology that promotes continuous improvement by reducing defects and

enhancing customer satisfaction. It is widely adopted across various industries to optimize processes and increase efficiency and effectiveness [3].

AN OVERVIEW OF LIBYAN TELECOMMUNICATION SECTOR

The Libyan telecommunications' sector has undergone a significant transformation, shaped by a history of technological advancements and innovation. In 1984, the government took a crucial step by establishing the General Post and Telecommunications Company (GPTC) to modernize the country's communication infrastructure, laying the foundation for future growth, followed by comprehensive reforms in 2002 to enhance the sector's efficiency and competitiveness.

As part of these reforms, Libya Telecommunications and Technology (LTT) and Almadar Aljadid merged into GPTC, leading to a reduction in service costs. To address the increasing demand for mobile communication, the government introduced a new competitor, Libyana, which focused on rapid expansion and affordability to enhance mobile service accessibility. In 2004, Libyana launched its GSM-based mobile services, initially covering Tripoli, Benghazi, and Sabha, marking a major milestone in expanding connectivity across the entire country.

In 2008, the General Authority for Communications (GAC) was established, and the Libyan Post, Telecommunications & Information Technology Company (LPTIC) underwent restructuring, assuming control over key telecommunications companies within Libya.

In recent years, wireless communication has expanded significantly, driven by the widespread adoption of internet and mobile services. This advancement has enabled seamless interaction among citizens, government agencies, and businesses, fostering a more interconnected and dynamic society [4].

The Libyan telecommunications industry shows considerable potential for further growth and investment. By prioritizing innovation and addressing the digital divide, the sector is expected to play an increasingly vital role in the country's economic development and overall prosperity.

LITERATURE REVIEW

This literature review evaluates the effectiveness of the 6-Sigma methodology in quality improvement across various sectors, with a particular focus on telecommunications and insights drawn from Libya. Globally, 6-Sigma has become an essential tool for addressing competitive challenges, enhancing customer satisfaction, and improving operational efficiency. However, despite its widespread adoption, there remains limited research on its application in emerging markets like Libya. This review seeks to bridge that gap by examining how 6-Sigma can be adapted to the Libyan telecommunications' sector, considering its unique challenges and opportunities.

Among this research, Harry and Schroeder [5] identified one of the oldest barriers to the implementation of 6-sigma such as the lack of leadership support as in many cases, leaders were skeptical of its benefits and, therefore, were not willing to invest in this subject area. This lack of leadership support made the situation much difficult for organizations to allocate resources and build the necessary infrastructure to support 6-sigma initiatives. Furthermore, Antony and Banuelas [2] highlighted other significant barriers for implementing 6-sigma such as resistance to change as many employees resist

change, and the implementation of 6-sigma often requires a significant cultural shift within the organization. This resistance can manifest in various ways, such as a lack of buy-in from employees, unwillingness to participate in 6-sigma initiatives, and a lack of trust in the methodology itself [2]. Similarly, Sangode and Hedaoo [6] studied the barriers of 6-sigma implementation in 35 industrial establishments. The study identified 10 key barriers, with poor project selection being the most significant contributor to 6-sigma's lack of adoption by organizations. In line with this, Elgadi et al. [7] agreed with Sangode and Hedaoo [6] about the barriers of 6-sigma implementation, resulting in a flexible and seamless framework for the Libyan industrial sector to adopt 6-sigma without facing the same barriers.

Numerous studies have demonstrated the efficacy of 6-Sigma in the telecommunications industry. For instance, Shukla and Srinivasan [8] reported the successful implementation of 6-Sigma at Bharti Infotel, leading to improved efficiency and increased innovation. Similarly, Khandelwal and Khandelwal [3] illustrated how 6-Sigma enabled telecommunications companies to address competitive pressures through customer-centric strategies. Further supporting this, Bhargava et al. [9] employed a binary logistic regression model to predict customer churn, contributing to more effective retention strategies. Expanding on these findings, Yang et al. [10] demonstrated that integrating design tools within the 6-Sigma framework at Shanghai Telecommunications Ltd. resulted in significant operational and economic gains.

In contrast, the Libyan context presents a distinct set of challenges. Research on quality management practices in Libya, including 6-Sigma and Total Quality Management (TQM), has identified key barriers for a successful implementation. For example, Abusa and Gibson [11] found that insufficient training and a lack of expertise hindered the effective adoption of TQM, emphasizing the need for capacity-building initiatives. Conversely, Masoud [12] highlighted the advantages of TQM in enhancing the performance of Libyan banks, reinforcing the broader applicability of structured quality improvement methodologies. Similarly, Al-Swidi et al. [13] confirmed the positive impact of TQM on organizational performance in Libyan banks, especially when mediated by market orientation, which highlights the importance of customer focus in achieving quality outcomes. Additionally, Elfaituri and Saad [14] emphasized the role of national culture as a critical factor affecting the implementation of TQM in Libya, noting that dimensions such as high-power distance and masculinity may obstruct quality efforts.

Overall, while global research underscores the significant benefits of 6-Sigma in improving operational efficiency and competitiveness, Libyan studies reveal that successful implementation in developing economies is constrained by factors such as inadequate training and limited expertise. This highlights the necessity of adopting a strategic, customer-focused approach coupled with targeted capacity building measures to fully harness the potential of 6-Sigma within Libya. Further research is required to assess its long-term impact and to tailor quality improvement practices to the unique challenges faced by developing economies such as the Libyan case.

RESEARCH METHODOLOGY

Despite the recognized global effectiveness of the 6-Sigma methodology in improving quality and operational efficiency, the Libyan telecommunications sector faces several challenges that hinder its successful adoption. This study investigates the primary barriers impeding the implementation of 6-Sigma, aiming to address a critical gap in

research concerning its application within emerging markets like Libya. The study adopts a mixed-method research approach, integrating qualitative and quantitative methodologies to provide a comprehensive analysis of the barriers of 6-Sigma implementation within the targeted area of research. In the first phase, qualitative methods were used through in-depth interviews with key stakeholders to explore their perceptions, challenges and attitudes towards 6-sigma adoption. However, due to the sensitive nature of the targeted individuals' positions, the total number of interviews conducted was 15. The insights gained from this stage contributed to the development of a structured questionnaire, which indicates an inductive approach in designing the research instrument based on the initial qualitative results.

In the second phase, the questionnaire was administered to collect the required data and information from 360 respondents, which were subsequently analyzed using a deductive approach to assess the prevalence and impact of the identified barriers. By integrating qualitative and quantitative methods, the study provides a holistic understanding of the key factors influencing 6-Sigma implementation stages. The study identified and ranked 15 critical barriers to 6-Sigma adoption, derived from the literature review. These barriers are illustrated with their occurrence frequency in Table (1).

Table 1: Identified and ranked barriers summarized from the literature review.

#	Investigated barrier	Frequency
1	Poor top management commitment	6
2	Lack of training courses	6
3	Lack of knowledge and awareness about 6-Sigma	6
4	Internal resistance (resistance to change)	5
5	Poor 6-Sigma project selection	5
6	Lack of resources (financial, human, time)	4
7	Lack of management and leadership from top executives	4
8	Insufficient organizational alignment	4
9	Considering 6-Sigma too complex to implement	3
10	Wrong / bad identification of process parameters	3
11	Incompatible and poor local standards with the international standards	3
12	Poor strategic competence and employee involvement	3
13	Lack of performance measurement	2
14	Insufficient interdepartmental communication	2
15	Difficulty in collecting data / data quality	2

QUESTIONNAIRE DESIGN AND PILOT TEST

Designing an effective questionnaire is a critical step in ensuring accurate and meaningful data collection. In this study, the questionnaire was carefully structured to align with the research objectives and facilitate reliable responses. It was developed following established guidelines from research methodology experts, ensuring clarity,

logical organization, and relevance to the study's objectives. The questionnaire comprised three main sections, demographic information; general questions on management systems; quality methodologies; and barriers of 6-Sigma implementation.

A five-point Likert scale was employed to ensure response accuracy while maintaining ease of analysis. To enhance accessibility, the questionnaire was originally designed in English and later translated into Arabic using the forward translation method, ensuring both linguistic and contextual accuracy. For evaluating its validity and reliability, a pilot test was conducted with three subject-matter experts. Their feedback confirmed the questionnaire's clarity, appropriateness, and effectiveness for data collection. Furthermore, Cronbach's alpha was calculated to measure internal consistency, yielding a high reliability score of 0.922, indicating strong coherence among the questionnaire items and content. This rigorous design process ensured that the questionnaire effectively captured data on the barriers of 6-Sigma implementation within the Libya telecommunications' sector, providing a robust foundation for meaningful analysis.

DATA COLLECTION, ANALYSIS, AND DISCUSSIONS

Nine state-owned telecommunications' companies, along with the General Authority for Information and Communications Technology, were targeted for this study. The questionnaire consisted of 88 questions covering quality management issues, related tools, and barriers identified in previous research. It was distributed in three separate phases, with a total of 1,446 hard copies disseminated across all phases. Out of these, 436 responses were received, resulting in an overall response rate of about 30%, providing insight into the engagement of the targeted entities with the survey. The analysis specifically focused on the third phase, during which 859 hard copies were distributed, achieving a 69% response rate. Table (2) presents a comprehensive overview of the total number of distributed and received copies for each targeted company, along with the corresponding response rates for each phase.

The licensed SPSS software (version 29) was used to analyse participants and company's data, including age, position, education levels, experience years, company size, ownership type, quality system, and 6-Sigma expertise. Descriptive statistics such as frequencies and percentages, were used to summarize the participant and company characteristics. Mean-score tests were conducted to assess the barriers in the implementation of 6-Sigma. Factors affecting barriers to the adoption of 6-Sigma were identified and analyzed. The descriptive analysis in this study provides an overview of the data collected, helping to understand the barriers and challenges related to the topic. Additionally, it clarifies the relationships between different variables, providing a foundation for accurate and reliable conclusions.

Table 2: Overall response rate of questionnaires across three phases.

Target Company	Hard Copies Distributed	Received Copies	Response Rate%
LPTIC	30	15	50
Libyana	216	45	21
Almadar	230	50	22
LTT	70	35	50
Aljeel	240	60	25
LITC	160	80	50
Hatif Libya	160	40	25
Libya Post	160	66	41
Al-Bunya	160	30	19
GAC	20	15	75

Participant's Age Group

The findings indicate that about 48% of participants are within age group of 36-45 years, playing a key role in driving quality initiatives, as they combine practical experience with strategic vision, ensuring the effective implementation of any improvement methodologies. The 20-35 age group is found to be with 26%, contributing fresh perspectives and adaptability, while 22% of participants are over 45, offering extensive expertise within the targeted sector.

These findings suggest that Libyan telecommunications' workforce is predominantly experienced and stable, creating a strong foundation for the successful adoption of structured quality methodologies such as 6-Sigma. Figure (1) illustrates these results, providing a visual representation of the age distribution among participants.

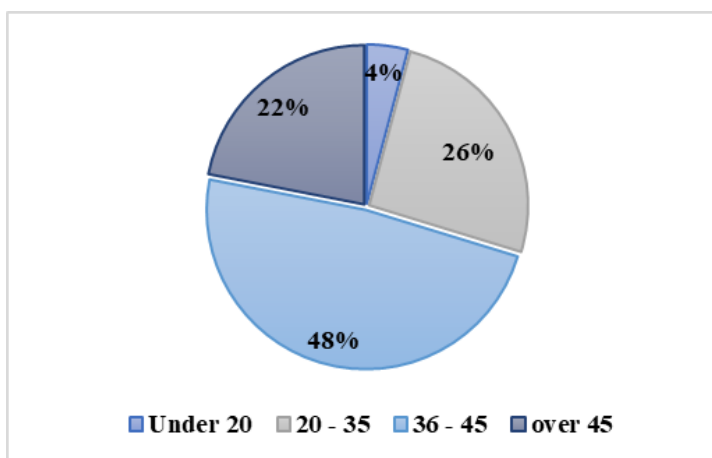


Figure 1: Participant 's age group.

Participant’s Job Titles

The results show that approximately 53% of the participants are employees (at different management levels), followed by project managers with 12% from the total. This distribution underscores the critical role of employees in daily quality operations, as they are directly responsible for executing processes and maintaining standards. While project managers are to be considered as essential in driving improvement initiatives and ensuring the effective integration of quality methodologies into workflows. These two roles are interconnected, as the success of 6-Sigma implementation depends on their collaboration in overcoming identified barriers. The findings suggest that empowering employees through targeted training is crucial for enhancing their ability to apply quality techniques and address specific challenges. Moreover, project managers must take an active leadership role, ensuring that improvements are aligned with the organization's strategic goals. Strengthening the capabilities of both groups is key to overcoming critical barriers for implementing 6-Sigma such as insufficient training, resistance to change, and lack of management support. Figure (2) illustrates the distribution of participants' job titles, highlighting the key roles required to address barriers to successful 6-Sigma implementation.

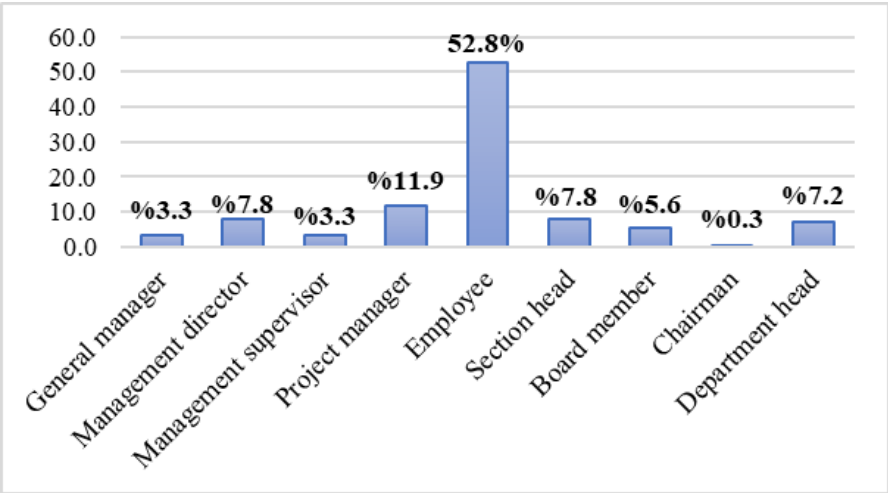


Figure 2: Participants current positions.

Participants’ Education Levels

The findings indicate that while approximately 60% of participants hold a bachelor's degree and 16% possess a master's or doctoral degrees, this educational background alone does not necessarily lead to the successful adoption of 6-Sigma in the telecommunications' sector. Despite the presence of qualified professionals, significant barriers still hinder the effective implementation of quality improvement methodologies.

The key challenge lies in the gap between theoretical knowledge and practical application. Even with higher degrees, employees may lack specialized training in structured methodologies such as 6-Sigma, making it difficult to integrate these approaches into daily operations. Moreover, project managers, despite their educational qualifications, may encounter obstacles such as resistance to change, insufficient organizational support, and limited access to resources essential for effective implementation.

This workforce structure underscores the urgent need for targeted interventions to bridge these gaps. Employees require focused training that not only enhances their understanding of quality improvement techniques but also equips them with the skills necessary to overcome organizational resistance and operational challenges. Similarly, project managers must be empowered with strategic leadership development to drive change effectively and align 6-Sigma initiatives with broader organizational goals. Figure (3) illustrates these findings, presenting the distribution of participants' education levels while emphasizing the necessity of addressing the barriers that impede the successful adoption of 6-Sigma in the surveyed sector.

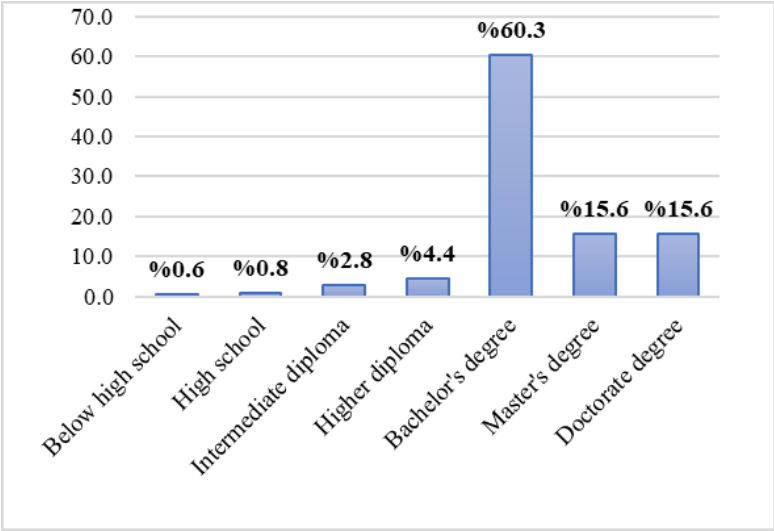


Figure 3: Participants educational levels.

Practiced Quality Management Systems

This section focuses on practiced quality management systems in the sector, where general questions were posed in the questionnaire to assess participants' knowledge of these systems. The analysis evaluates participants' understanding of the fundamental concepts of quality systems and their application in the workplace.

The data reveal that ISO 9001 is the most widely adopted quality management system (28.3%), followed by TQM. In contrast, 6-Sigma has the lowest adoption (3.6%). This highlights the limited adoption of 6-Sigma within the Libyan telecommunications' sector, indicating that while ISO 9001 and TQM are more widely established, 6-Sigma has yet to gain significant traction.

At the participant level, the results show that professionals with varying levels of experience and education are involved in the decision-making and implementation of these quality systems. Despite the widespread use of ISO 9001 and TQM, participants may face challenges at different organizational levels, such as resistance to change or insufficient training, which can hinder the effective implementation of more advanced systems like 6-Sigma. This limited adoption of 6-Sigma suggests a need for tailored strategies to promote its integration and enhancing its effectiveness over traditional methods. Addressing barriers such as lack of specialized training, resources, and organizational support are crucial for improving the overall performance and

effectiveness. Figure (4) provides a visual summary of these findings, illustrating the varying levels of adoption of different quality management systems within the participating companies in the Libyan telecommunications' sector.

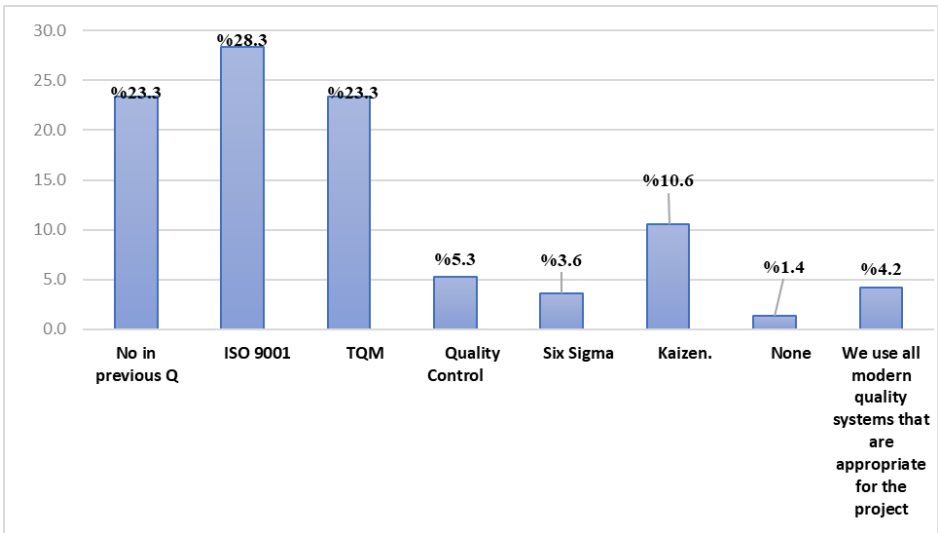


Figure 4: Current quality system.

Implementing 6-Sigma responsibilities

Project managers are perceived as the primary drivers of modern quality systems, as about 31.4% of the participants pointed out this reality, while senior managers are also considered as the seconded drivers of the successful implementation of 6 sigma as seen by about 26% of the participants, as demonstrated in Figure (5). These findings highlight the importance of close collaboration between leadership and project managers to ensure the effective implementation of 6-Sigma.

The findings indicate that the successful implantation of 6-Sigma largely depends on functional integration between project managers and senior leadership. Project managers contribute practical execution skills, ensuring that quality improvements are effectively applied, while senior management provides strategic direction and allocates resources to sustain operations.

Without this synergy, implementation efforts may encounter significant challenges, such as resistance to change, insufficient funding, or misalignment with organizational objectives. Therefore, it is recommended to define clear roles, enhance training programs, and encourage leadership involvement to ensure the sustainable adoption of 6-Sigma and continuous organizational performance improvement. Figure (5) illustrates the distribution of responsibilities for implementing 6-Sigma, highlighting the distinct roles played by senior management and project managers for ensuring the methodology's effective application.

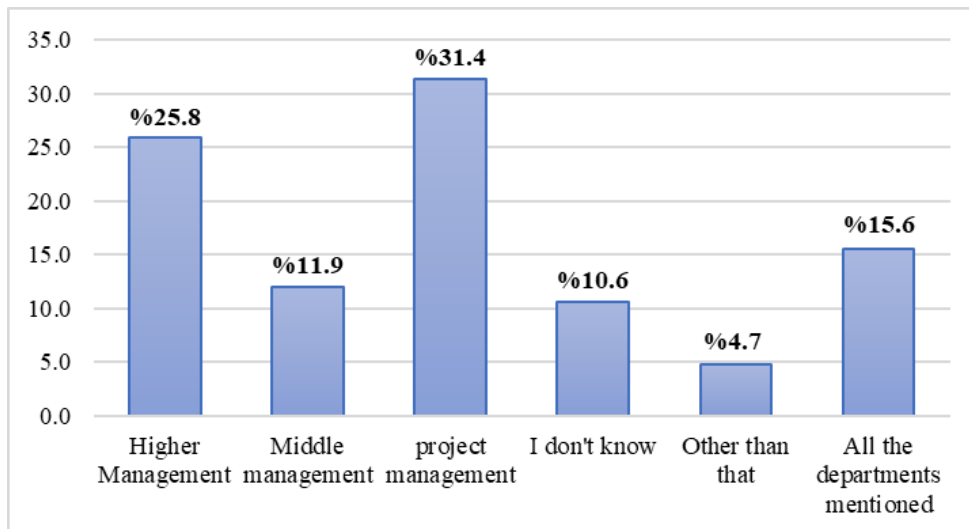


Figure 5: Responsibility for implementing 6-sigma.

BARRIERS AFFECTING THE ADOPTION OF 6-SIGMA IN THE LIBYAN TELECOMMUNICATION' SECTOR

A comprehensive analytical study of the Libyan telecommunications sector has identified five primary barriers to the adoption of the 6-Sigma methodology. The most significant challenge is internal resistance (resistance to change), with an average score of 3.45 out of 5 points on Likert Scale, indicating significant reluctance toward adopting the methodology. Additionally, other barriers were observed, including:

- Considering 6-Sigma is too complex with an average of 3.23, which may discourage its implementation.
- Incompatible and poor local standards with the international standards with an average of 3.01, which hinders the systematic application and local accreditation of 6-Sigma.
- Difficulty in collecting data with an average of 2.99 which limits the effectiveness of quality control procedures to ensure the quality of data and processes.
- Poor strategic efficiency and employee engagement are very close to the challenges of data collection with an average of 2.9, hindering sustainable implementation considering that the sustainable implementation needs constant data collection and updating.

The above barriers are the most influential on the implementation of 6-Sigma in the scope of the study according to the opinion trend of the five-point Likert, however, there are other barriers among the 15 barriers that were studied that also affect the implementation of 6-Sigma in the telecommunications' sector in Libya, among of them are:

- Insufficient interdepartmental communication, which slow down cross-functional coordination and response to development in work methodologies.
- Top management commitment, suggesting that leadership support exists but needs further reinforcement.

- Resource availability in the form of time, financial assistance, and human, indicating that while a resource deficiency exists, it is not a dominating factor.
- Inadequate knowledge and understanding of the methodology along with limited informational training opportunities, demonstrating heightened skill and capacity deficiencies.
- Absence of performance measurement framework coupled with an absence of primary leadership engagement illustrates under developed managerial and structural frameworks.

These findings clearly illustrated that about 73% of the early mentioned 15 barriers being examined, and had an effect in one way or another on the execution of 6-Sigma inside the telecommunications' sector in Libya.

These discoveries highlight the need of integrating alter administration techniques, strengthening administration commitment, and cultivating capacity-building initiatives to guarantee the fruitful selection of 6-Sigma within the Libyan broadcast communications division. Figure (6) outlines the distinguished boundaries, giving a comparative examination of their effect on 6-Sigma usage.

The positive point that can be clearly relished, while research such as that by Elgadi et al. [7] has theorized flexible frameworks for constructing 6-Sigma implementation within the industrial sector of Libya, the current research asserts the necessity for such similarly customized frameworks within the telecommunication sector. Such frameworks should include mechanisms for change management, greater leadership involvement, as well as institutional capacity development. These findings also support the assertions of researchers such as Abusa and Gibson [11], who theorized that structural and training programs are crucial enablers for effectively implementing quality methodologies.

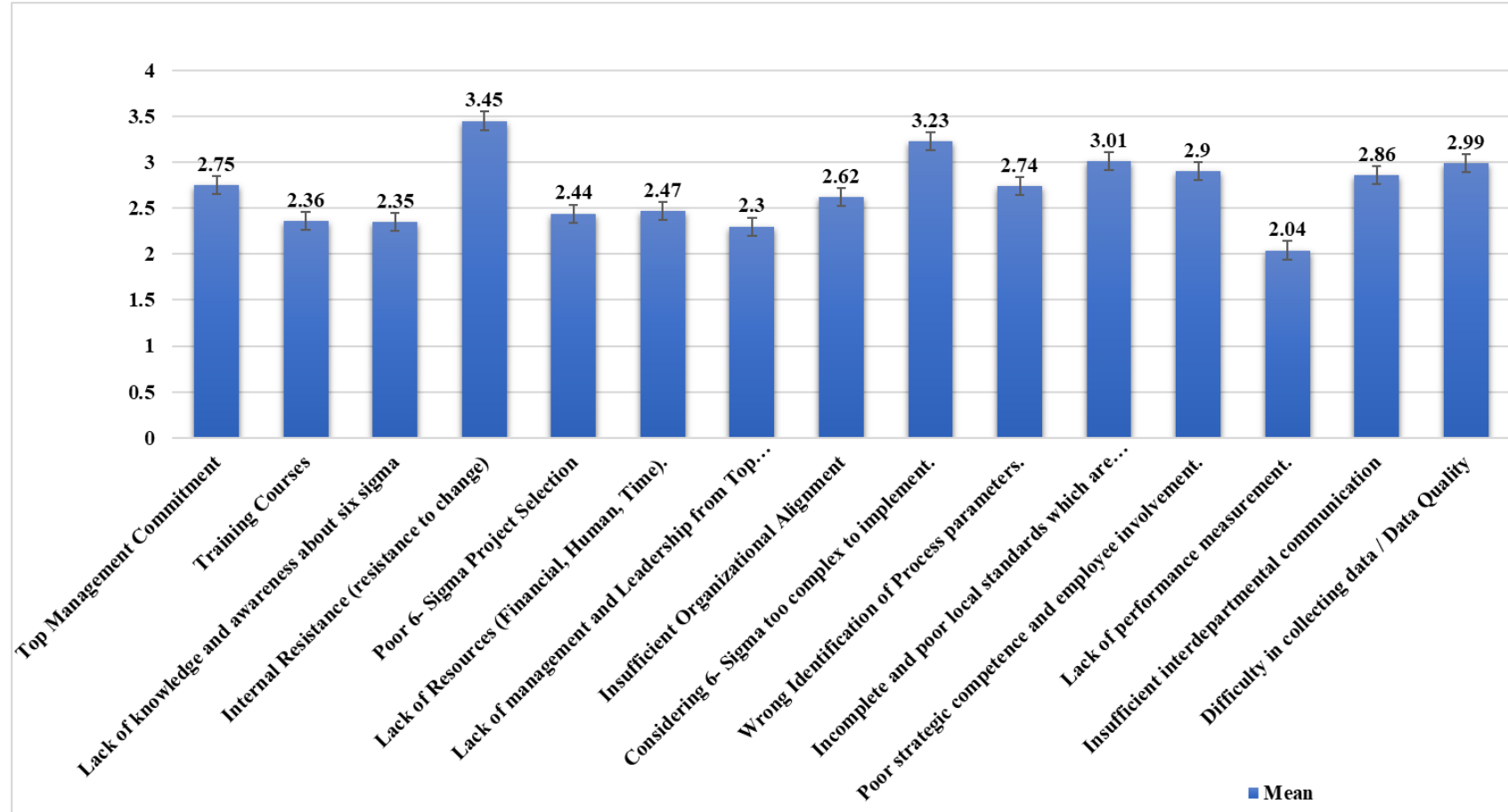


Figure 6: Barriers affecting 6-sigma in the Libyan telecommunications' sector.

CONCLUSIONS

An analysis of the Libyan telecommunications' sector, derived from a survey conducted in this study, reveals that the successful implementation of 6-Sigma depends on overcoming several critical barriers. The key findings are summarized as follows:

- **Resistance to Change:** Resistance among employees and organizations highlights the urgent need for well-structured change management strategies that cultivate a culture of adaptability and openness.
- **Perceived Complexity:** The perceived complexity of 6-Sigma among stakeholders emphasizes the need for structured awareness campaigns and specialized training programs designed to demystify the methodology and highlight its practical advantages.
- **Absence of Local Standards:** The lack of nationally recognized standards aligned with international benchmarks underscores the necessity of developing a standardized national framework to facilitate the structured adoption of 6-Sigma, ensuring alignment with global quality benchmarks.
- **Data Collection Challenges:** Challenges in obtaining reliable data, coupled with concerns over data quality, underscore the critical need for advanced data management systems and extensive staff training in data collection and analytical methodologies.
- **Weak Strategic Efficiency and Limited Employee Empowerment:** The absence of clear strategic alignment and insufficient employee involvement in decision-making hinder the effective adoption of 6-Sigma, necessitating robust goal-setting initiatives and enhanced empowerment programs to drive successful implementation.

Building on these findings, a set of actionable scenarios has been devised to translate the results into effective strategies that facilitate the successful adoption of 6-Sigma in the Libyan telecommunications' sector:

- **Change Management Initiatives:** Design and execute comprehensive change management programs, including workshops and training sessions, to adequately prepare employees for the transition to 6-Sigma and facilitate a seamless adaptation process.
- **Awareness and Training Programs:** Initiate extensive training campaigns to educate employees on the principles, tools, and techniques of 6-Sigma, utilizing real-world examples and case studies to illustrate its practical benefits.
- **Standard Development:** Collaborate with industry stakeholders and regulatory bodies to develop national standards that align with international best practices, creating a clear framework for the efficient implementation of 6-Sigma.
- **Enhanced Data Management Practices:** Invest in state-of-the-art data management systems and provide comprehensive training in effective data collection and analysis techniques to address data-related challenges and improve the reliability of quality enhancement processes.

- **Empowerment and Strategic Alignment:** Empower employees by actively involving them in decision-making related to quality improvement and align the organization's strategic goals with 6-Sigma objectives to cultivate a supportive environment for continuous improvement.

By addressing these barriers through the proposed scenarios, telecommunications' companies, along with other sectors in Libya, can significantly improve operational efficiency, enhance customer satisfaction, and gain a competitive advantage within the entire business area.

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