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OPERATIONAL COMMUNICATIONS PROCESS AND PERFORMANCE: ROLE OF LEAN SIX SIGMA CRITICAL SUCCESS FACTORS

Vimala Venugopal Muthuswamy[1*] and Dr. D. Dilip[2]

[1]Department of Management, College of Business, King Faisal University, Al-Ahsa 31982, Saudi Arabia.
[2]Assistant professor, VIT Business School, Vellore, Tamil Nadu.

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Research Paper

Abstract: *The study aimed to examine how success factors of six sigma impact operations performance by analysing the operations communications process. For this purpose, data was collected through a self-administered questionnaire from 300 employees of the service industry using the purposive sampling technique. Employed a quantitative research approach and utilised a cross-sectional research design. The results of the PLS-Structural Equation Modelling technique indicate that various factors, such as project prioritising and selection reviews, project success stories, best practices and benchmarking, an effective lean six-sigma training programme, company involvement in lean six-sigma, and cultural change in LSS projects, have a positive and significant impact on operational performance. In simple terms, the findings indicate that the communication process in operations plays a crucial role in mediating the relationship between lean six-sigma practices and the performance of the service industry in Saudi Arabia. The study's significant mediating effect has made a valuable contribution to the existing literature, providing a foundation for other researchers to further explore their research using an expanded model. In practical terms, the findings provide valuable insights for service organisations in Saudi Arabia, highlighting the importance of prioritising effective communication channels throughout the duration of projects.*

Keywords: *Lean six sigma factors, operations performance, operations communication, Saudi Arabia.*

*Corresponding Author: fmuthuswamy@kfu.edu.sa (V.V.Muthuswamy), Dilip.d@vit.ac.in (D. Dilip)

1. Introduction

The performance of operations plays a crucial role in helping companies achieve their strategic objectives and stay competitive in today's ever-changing business landscape (Buer et al., 2021). It encompasses a broad array of activities focused on effectively providing products and services to customers, all while minimising expenses and maximising the creation of value (Cesarotti, Gubinelli, & Introna, 2019). Attaining high levels of operational performance is crucial for organisations in all sectors, as it directly influences the overall success of the organisation. As a result, understanding the elements that impact operations performance is important for organisations aiming to excel in today's competitive market landscape. Efficient communication is essential for improving operational performance by promoting coordination and information sharing among stakeholders involved in operational activities (Kjærgaard, Leon, & Fink, 2015). Operations communication entails the sharing of information, feedback, and instructions among various levels of the organization as well as with external partners and suppliers (Kjærgaard et al., 2015). By fostering transparent and open communication channels, organisations can enhance decision-making processes and align operational efforts with strategic goals, ultimately boosting performance (Kim et al., 2020; Prajogo et al., 2018).

In addition, the adoption of Lean Six Sigma practices has become a crucial factor in improving operations performance. It focuses on efficiency, reducing waste, and promoting continuous improvement (Hill et al., 2018). Lean Six Sigma is a powerful methodology that integrates lean management and Six Sigma to enhance processes, eliminate activities that don't add value, and encourage employees to identify and resolve operational inefficiencies (Muhammad et al., 2022). Importantly, Lean Six Sigma methodology places equal emphasis on operational processes and the significance of effective communication and collaboration among employees across all levels of the organisation (Gastelum-Acosta et al., 2022). By fostering a culture of ongoing improvement and empowering employees to contribute to operational excellence, Lean Six Sigma practices have the potential to enhance communication processes within operations, leading to improved performance. Thus, the research examines the impact of six-sigma lean practices on operational performance by analysing the operations communication process.

In the context of the Saudi Arabian service industry, there is a limited number of empirical studies that have examined the relationship and impact of operations communication and Lean Six Sigma practices on organisational outcomes. However, it is widely recognised that these practices play a crucial role in driving operational performance. Previous studies have yielded valuable insights into the impact of operations communication and Lean Six Sigma practices on performance (Gastelum-Acosta et al., 2022; Kalogiannidis, 2020; Kim et al., 2020; Selvaraju, Bhatti, Sundram, & Azmir, 2019). However, there is a significant research gap regarding the combined impact of these factors on operational performance, particularly in relation to service organisations operating in developing nations. Prior studies have examined different aspects of lean practices, such as project prioritisation, selection, reviews, and tracking; project success stories; best practices and benchmarking; and effective lean six-sigma training programmes (Selvaraju et al., 2019).

Other studies have focused on the involvement of company staff in LSS projects or cultural change within LSS projects (Gastelum-Acosta et al., 2022). However, there is a lack of comprehensive research that considers all these components together. Prior

research has primarily examined the direct impact of lean practices on operational performance (Ciasullo et al., 2024; Hill et al., 2018; Liu, Wang, Niu, & Mo, 2024; Selvaraju, Bhatti, Sundram, & Abd Rahim, 2019). However, there has been limited attention given to the influence of lean six-sigma practices on operations performance through the operations communication process. In previous studies, there have been varying findings and a lack of thorough examination of how operations communication and Lean Six Sigma practices contribute to improving performance in service contexts (Gastelum-Acosta et al., 2022; Kalogiannidis, 2020; Kim et al., 2020; Selvaraju, Bhatti, Sundram, & Abd Rahim, 2019). This study aims to fill the existing gaps by examining the impact of Lean Six Sigma practices on operations performance in the service industry of Saudi Arabia, specifically focusing on the operations communication process.

Prior research has emphasised the significance of the service industry's operational performance in Saudi Arabia for driving economic growth. In addition, the lean six-sigma methodology enhances efficiency, minimises waste, and optimises processes to enhance service quality and operational performance. Implementing Lean Six Sigma has the potential to optimise operations, enhance productivity, and create a competitive edge within Saudi Arabia's service sector (Hani, 2021). Thus, the study centres on the service industry in Saudi Arabia and aims to contribute to the existing research by exploring the role of operations communication in Lean Six Sigma initiatives, particularly in the context of the Saudi Arabian service industry. This research enhances our comprehension of how effective communication practices contribute to the success of operational improvement efforts. In practical terms, the findings provide valuable insights for service organisations in Saudi Arabia, highlighting the importance of prioritising effective communication channels throughout the duration of projects. Incorporating communication strategies into project management practices can help reduce risks, improve resource allocation, and boost service quality and operational efficiency. The study was organised into four additional chapters: "literature review, research methodology, data analysis and results, discussion, and future directions."

2. Literature Review and Hypothesis Development

The integration of Lean Management and Six Sigma methodologies in Lean Six Sigma aims to minimise costs and eliminate waste throughout organisational processes. For example, Akanmu, Othman, and Yousaf (2022) highlight the importance of utilising Lean Management techniques throughout the entire project, from start to finish, in order to address cost inefficiencies. Both Lean and Six Sigma offer valuable insights and knowledge to tackle a range of operational challenges. When implemented together, they can lead to significant improvements (Cesarotti et al., 2019). In lean sigma, there are multiple factors at play. Effective communication and assessment play a crucial role in Lean Six Sigma initiatives within organisations. The authors emphasised the significance of communication and assessment as crucial factors in developing effective strategies and enhancing performance (Altschuller & Benbunan-Fich, 2010). In addition, effective communication fosters the cultivation of shared values, mutual goals, and a sense of trust, ultimately enhancing the organisation's competitive edge (Altschuller & Benbunan-Fich, 2010).

Research studies highlight the crucial role of strong communication and evaluation in enhancing operational performance in Lean Six Sigma (LSS) frameworks. In a study conducted by (Selvaraju, Bhatti, Sundram, & Abd Rahim, 2019), it was found that organisations that focused on maintaining effective communication channels and regularly evaluating their LSS initiatives saw significant enhancements in their operational performance. In a recent study by Marodin, Chiappetta Jabbour, Godinho Filho, and Tortorella (2023), they discovered a noteworthy correlation between effective communication of LSS results and improved performance. (Stainback IV, 2011) highlighted the importance of assessment practices and discovered a strong correlation between these methods and operations. In a recent study conducted by Zheng, Stein, and Farzan (2023), additional analysis supported these findings. The study showed that when LSS goals and progress are communicated transparently, it fosters a culture of collaboration and accountability. This, in turn, leads to notable improvements in operational performance, such as significant reductions in defects and cycle times. Keeping in view the empirical studies, following research hypothesis below,

H1: *The lean six sigma communication and assessment has significant impact on operational performance.*

Additionally, the effectiveness of lean Six Sigma implementation relies heavily on attaining optimal project performance. It is essential to establish appropriate criteria for project selection and prioritisation. The authors, Bhat, Gijo, Antony, and Cross (2023), emphasised the significance of accurately classifying projects based on their organisational importance. To achieve this goal, they highlighted an intuitive attribute prioritization process. Inadequately chosen or defined projects can result in delays and employee dissatisfaction. In a recent study conducted by Francescatto, Neuenfeldt Júnior, Kubota, Guimarães, and de Oliveira (2023), they discovered a significant correlation between project selection strategies and performance. Their findings provide empirical evidence supporting the notion that effective project selection strategies can have a positive impact on overall performance. Vashishth, Lameijer, Chakraborty, Antony, and Moormann (2024) conducted a recent study that revealed the importance of actively monitoring project status. Their findings revealed that organizations that implemented real-time tracking mechanisms experienced significant improvements in production lead times and defect rates. Considering the perspective of empirical researchers, following hypothesis is formulated below,

H2: *Lean six sigma selection, prioritization and projects have significant influence on operational performance.*

The previous literature has highlighted several inconsistencies when it comes to sharing success stories, best practices, and benchmarking. Various leaders in different organisations have implemented successful strategies that can be replicated to achieve favourable outcomes (Selvaraju, Bhatti, Sundram, & Abd Rahim, 2019). Best practices cover a variety of approaches, including widely accepted standards in the industry or practices supported by reputable companies (Panigrahi et al., 2023). In order to enhance continuous improvement, organisations must establish consistent processes for benchmarking and implementing best practices. Research suggests that equipping all employees within a company with additional knowledge is crucial to preventing errors that may result in project implementation failures. Based on the research conducted on knowledge-based systems (KBS), it has been found that comparing project performance with international best practices can significantly

improve it (Selvaraju, Bhatti, Sundram, & Abd Rahim, 2019). Implementing this strategy, with the backing of senior leadership and utilising effective benchmarking and decision-making techniques, can greatly enhance organisational performance (Aytekin et al., 2023).

H3: *The lean sigma project success stories, benchmarking and best practices has significant influence on operational performance.*

Training programmes within Lean Six Sigma initiatives are specifically designed to improve employee learning and job-related knowledge. These programmes led by organisational leaders strive to enhance employee performance, which can give the organisation a competitive advantage (Vashishth et al., 2024). According to a study conducted by Vashishth et al. (2024), it was found that training programmes have a significant impact on improving operational performance. Raval, Kant, and Shankar (2020) conducted a recent study that revealed the high effectiveness of training programmes in enhancing employee skill sets and problem-solving abilities. As a result, these improvements have directly translated into noticeable performance enhancements within manufacturing processes. Inan, Gungor, Bititci, and Halim-Lim (2022) provided additional support for these findings and emphasised the significance of LSS training in fostering a culture of continuous improvement and innovation within organisations, ultimately enhancing operational performance. Past research has demonstrated the significance of training programmes for enhancing operational performance. Therefore, study has following hypothesis,

H4: *The Lean Six Sigma training program has significant influence on operational performance.*

The active participation of senior leadership was crucial in enhancing operational performance. For instance, Raval et al. (2020) study found a strong and positive correlation between top management involvement and the improvement of operational performance. In a similar vein, another study by Madhani (2022) emphasised the significant role of top management in enhancing operational efficiency through lean six sigma practices. In a study conducted by Shofia, Bakhtiar, and Prastawa (2020), it was found that employees who were actively involved in their work were more inclined to recognise and implement process enhancements that led to increased productivity and reduced costs. In addition, the analysis conducted by Iberahim, Azman, Shahri, and Hamid (2020) emphasised the significance of empowered employees in enhancing performance and gaining a competitive advantage. Therefore, following research hypothesis is formulated below,

H5: *The Company staff involved in LSS projects has significant impact on operations performance.*

Furthermore, the cultural shift within the six-sigma projects was crucial to enhancing operational performance. As demonstrated in a study conducted by Raval et al. (2020), cultural change has a significant impact on performance by enhancing quality. In a study conducted by Kumar et al., (2023), they discovered that cultural transformation initiatives implemented in LSS projects had a positive impact on employee engagement and organisational resilience. This, in turn, resulted in noticeable improvements in manufacturing processes and overall performance. In a recent study by Sony, Naik, and Antony (2020), they emphasised the significance of cultural change in fostering employee motivation and dedication to enhancing process

improvement initiatives. Moreover, a study conducted by Delgado, Ferreira, and Castelo Branco (2010) showed that organisations that effectively implemented cultural change initiatives within LSS projects were more capable of overcoming resistance to change and achieving long-lasting improvements in operations performance. Therefore, study has following research hypothesis below,

H6: *Cultural change in LSS projects has significant impact on operations performance.*

Past research has highlighted the significance of lean six sigma practices in enhancing operational performance. However, it is interesting to note that previous studies have failed to consider the indirect impact of these practices on operational performance. In several previous studies, it has been argued that lean sigma practices have a significant impact on operational outcomes through mediating or moderating effects (Liu et al., 2024; Panigrahi et al., 2023). Thus, the present study is centred on examining the influence of lean six sigma practices on operational performance by considering the mediating effect of operations communication process. The study posits that enhancing lean six practices within an organisation can result in improved communication processes, ultimately leading to enhanced operational performance (Aytekin et al., 2023). Research has shown that regular communication and assessment play a crucial role in Lean Six Sigma (LSS) initiatives and have a significant impact on operations performance. A recent study by Marlow, Lacerenza, Paoletti, Burke, and Salas (2018) found that consistent communication and effective assessment practices in LSS initiatives can have a significant impact on important performance metrics, including process efficiency and employee satisfaction. Similarly, Francescatto et al. (2023) found that organisations placing a high value on open and clear communication, along with regular evaluation of LSS projects, experienced notable enhancements in their operational effectiveness and ability to innovate. In a study by Al Owad et al. (2023), it was found that organisations that fostered a culture of open communication and continuous feedback were more successful in identifying and resolving operational inefficiencies. This ultimately led to improved productivity and cost savings. Keeping in view previous empirical results, study has formulated a following research hypothesis below,

H7: *Frequent communication and assessment on lean sigma has significant impact on operations performance with mediating effect of operations communication process.*

In a recent study by Francescatto et al. (2023), they discovered a strong correlation between strategic project selection, prioritisation, project status monitoring practices, and key performance. They also emphasised the importance of enhancing communication processes as an effective means of improving performance. In a study conducted by Zehir and Zehir (2023), they discovered compelling evidence that demonstrates the connection between the implementation of systematic project management practices and the enhancement of communication flows and decision-making processes. This, in turn, has a positive impact on overall performance. Additionally, the research conducted by Swarnakar, Bagherian, and Singh (2023) highlights the importance of integrating project management and communication strategies. This integration allows for effective coordination and collaboration among cross-functional teams, ultimately leading to improved operational performance. Considering the previous empirical findings, study has formulated a following research hypothesis below,

H8: *Project selection, prioritization and project status has significant impact on operations performance with mediating effect of operations communication process.*

Swarnakar et al. (2023) found a strong correlation between knowledge sharing and benchmarking practices in LSS initiatives and key performance. They also put forth the argument that effective communication processes can significantly enhance performance. In a recent study, Ndrecaj, Mohamed Hashim, Mason-Jones, Ndou, and Tlemsani (2023) discovered that organisations that placed a high value on open and clear communication, as well as sharing knowledge about LSS projects, saw notable enhancements in their operational effectiveness and ability to innovate. Ndrecaj et al. (2023) conducted a study which found that organisations that fostered a culture of open communication and continuous learning were able to identify and replicate successful practices, resulting in improved productivity and cost savings. In addition, Maheshwari and Devi (2024) emphasised the significance of effective knowledge management and stakeholder engagement in achieving operational excellence through LSS projects. They underscored the need to establish platforms for sharing insights and lessons learned. Taking into account the previous empirical findings, study has formulated a following research hypothesis below,

H9: *The sharing of project success stories, benchmarking and best practice has significant impact on operations performance with mediating effect of operations communication process.*

Vashishth et al. (2024) conducted a study that revealed a noteworthy correlation between comprehensive Lean Six Sigma (LSS) training programmes and performance outcomes. In a study conducted by Delgado et al. (2010), they discovered concrete evidence that connected LSS training programmes to improved employee engagement and problem-solving abilities. This, in turn, resulted in measurable performance improvements in manufacturing processes. Maheshwari and Devi (2024) suggested that companies that prioritise effective training programmes and foster a culture of open communication are more likely to experience long-term improvements in their operational performance. Moreover, a study conducted by Mughal, Khan, Kumar, and Kumar (2020) focused on the role of effective training and knowledge transfer in driving operational excellence through LSS initiatives. The study highlighted the significance of equipping employees with the essential skills and resources to succeed, ultimately leading to improved operational performance. Considering the previous empirical findings, study has formulated a following research hypothesis below,

H10: *The Lean Six Sigma training program has significant impact on operations performance with mediating effect of operations communication process.*

Iberahim et al. (2020) conducted a study to examine the correlation between employee involvement in LSS initiatives and performance. The results revealed a noteworthy relationship between employee engagement and performance. In a recent study conducted by Linina, Zvirgzdina, and Tišlerova (2022), it was discovered that organisations that fostered a culture of employee involvement in LSS projects saw notable enhancements in operational effectiveness and innovation capabilities. Costa, Godinho Filho, Fredendall, and Ganga (2020) provided additional support for these findings, indicating that employees who are actively involved are more inclined to identify and implement process improvements. This, in turn, enhances communication and ultimately leads to improved performance. Taking into account

the previous empirical findings, study has formulated a following research hypothesis below,

H11: *The company staff involved in LSS projects has significant impact on operations performance with mediating effect of operations communication process.*

Sony et al. (2020) found a strong link between the implementation of cultural transformation initiatives in LSS projects and their subsequent performance. They also made the point that cultural change has the potential to enhance the communication process, leading to improved performance. In another study carried out by Francescatto et al. (2023), they discovered concrete evidence that connects cultural change initiatives to enhanced employee engagement and organisational resilience, resulting in measurable performance improvements. Belhadi, Kamble, Gunasekaran, Zkik, and Touriki (2023) found that organizations that fostered a culture of open communication and continuous improvement were more likely to achieve project success and drive operational excellence. Moreover, In their study, Vashishth et al. (2024) emphasised the significance of cultural alignment with LSS principles in achieving favourable project results. They underscored the need to foster a work culture that is supportive and inclusive. Lee, McFadden, Lee, and Gowen III (2021) conducted a recent study that revealed the significant impact of cultural change on enhancing organisational learning and adaptation. This, in turn, led to improved communication channels, operational excellence, and overall organisational success. Taking into account the previous empirical findings, study has formulated a following research hypothesis below,

H12: *Cultural change in LSS projects sigma has significant impact on operations performance with mediating effect of operations communication process.*

3. Research Methods

The study aimed to examine the influence of key factors of six sigma on operations performance by analysing the operations communications process within the telecommunications industry in Saudi Arabia. Researchers employed a quantitative research approach, widely regarded as the most effective method for testing existing theories, to achieve the goal (Almalki, 2016). In addition, researchers opt for the cross-sectional research approach to collect data at a specific moment from a sample, providing a snapshot of the current state of operational practices and excellence within organisations (Rindfleisch, Malter, Ganesan, & Moorman, 2008). This design enables the simultaneous exploration of various factors, offering a holistic comprehension of their impact on operational performance. Through the use of an explanatory research framework, this study aims to delve deeper into the causal mechanisms that drive the observed relationships using an explanatory research framework. Its goal is to shed light on why specific operational strategies result in higher levels of excellence (D. M. M. Ali, 2020).

3.1 Research Instrument and Data collection procedure.

The research instrument was adapted from previous studies where it had already been tested, demonstrating the reliability of the construct. The evaluation of LSS includes four items for communication and assessment, three items for project prioritisation, selection, reviews, and tracking, four items for project success stories,

practices, and benchmarking, and five items for measuring the effectiveness of the training programme. The measurements were obtained from a study conducted by (Selvaraju, Bhatti, Sundram, & Abd Rahim, 2019). Furthermore, Selvaraju and colleagues evaluate cultural change in LSS projects using four specific criteria and assess the level of participation and commitment from top management using seven different indicators. Gastelum-Acosta et al. (2022) derived the following items from their recent study. The operational performance is derived from five questions based on previous research conducted by (Flynn, Huo, & Zhao, 2010). The operations communication process was evaluated using a set of five items, which were derived from a study conducted by (B. J. Ali et al., 2021). All items in the study were measured using a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The questionnaire was distributed among employees in the service industry in Saudi Arabia. The respondents (employees) were selected using a purposive sampling technique, ensuring that they possess a certain level of knowledge of operations. The purposive sampling technique is widely recognised for its effectiveness in collecting data from specifically chosen individuals (Obilor, 2023). The survey was given to 420 employees from various service sectors. When the questionnaire was distributed, researchers allotted a three-hour time frame for participants to complete it. If participants were occupied during the distribution of the questionnaire, researchers offered an envelope with the address provided. A specific time frame of one week was allocated for completing the questionnaire. If the questionnaire was not returned within one week, the response was considered as non-response. Out of the total number of questionnaires received, 309 were returned and after excluding the incomplete responses, 300 were deemed suitable for further analysis. The response rate achieved was 71.42 percent. The above variables are predicted in Figure.1 below,

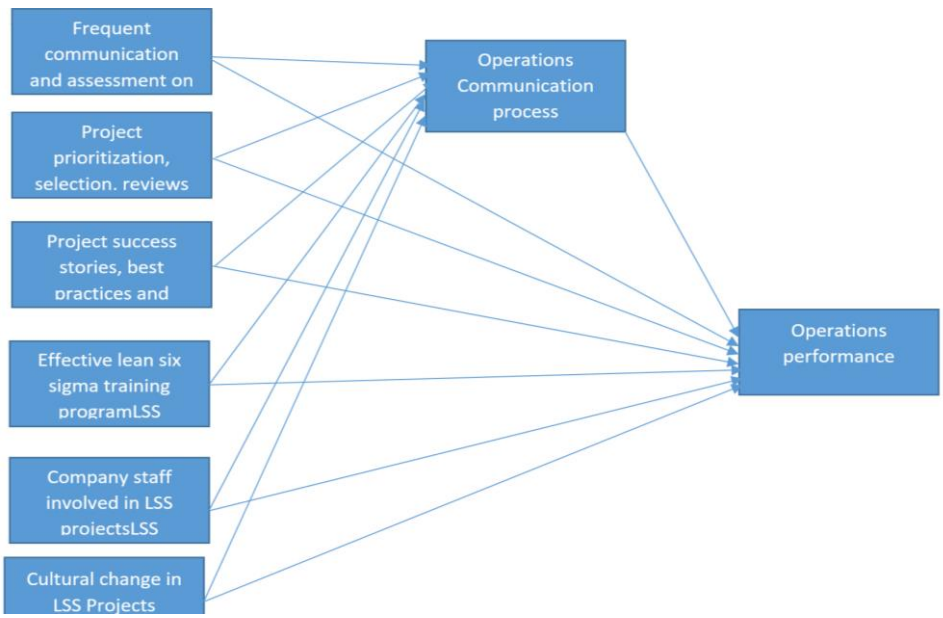

Figure 1: Conceptual Framework

3.2 Descriptive Statistics

The results presented in Table 1 display the descriptive statistics of the study. The

statistics provide an overview of the mean, standard deviation, minimum, and maximum values for different variables associated with organisational processes and performance. The organisation demonstrates strong levels of communication, with the communication and assessment (CA) scoring highest at 3.82 and the operations communication process (OCP) closely following at 4.05. The project selection and assessment (PSP) and operations performance (OP) have slightly lower mean scores of 3.65 and 3.80, respectively, indicating areas that may require improvement or attention. Project success stories and cultural change both show strong mean scores of 4.10 and 3.90, indicating positive aspects within the organisation. The training programme (TP) and the participation and commitment of top management involvement (PCTMI) both show mean scores of 3.75 and 3.68, respectively, suggesting moderate levels of effectiveness. The above results predicted in following Table.1 below,

Table.1: Descriptive Statistics

Variable	Mean	Standard Deviation	Minimum	Maximum
CA	3.82	0.68	1	5
PSP	3.65	0.72	1	5
SPSS	4.10	0.61	1	5
TP	3.75	0.67	1	5
PCTMI	3.68	0.69	1	5
CC	3.90	0.63	1	5
OCP	4.05	0.57	1	5
OP	3.80	0.70	1	5

Note: CA-communication and assessment, PSP-project selection and assessment, SPSS-sharing of project success stories, TP-training program, "PCTMI-participation and commitment of top management involvement, CC-cultural change, OCP-operations communication process", OP-operations performance.

3.3 Inferential Analysis

The study utilised the Partial Least Square (PLS)-Structural Equation Modelling (SEM) technique for the inferential analysis. The inferential analysis was conducted in two phases. The initial phase focuses on the measurement model, while the subsequent phase delves into the structural model. The next section will cover the discussion of these two models.

3.4 Measurement Model

The measured model can be evaluated based on its convergent and discriminant validity. In the realm of convergent validity, there is a focus on the extent to which various indicators align or capture the essence of a shared construct. One way to assess this is by looking at factor loadings, composite reliability, alpha, and average variance extracted (AVE). Among these, the alpha coefficients represent internal consistency. It is recommended that the value be greater than 0.7 (Hair Jr, Howard, & Nitzl, 2020). The factor loadings indicate the strength of the relationships between each indicator of the construct. It is recommended that the values be greater than 0.5, as this represents convergent validity (Hair, Hollingsworth, Randolph, & Chong, 2017). In addition, composite reliability evaluates the reliability of the construct as a whole. Values above 0.70 are generally considered acceptable, according to (Hair et al., 2017). Simply put, AVE assesses the extent to which the construct accounts for the measurement error. Values above 0.50 are considered indicative of strong convergent

validity (Hair Jr et al., 2020). In addition, the VIF values are less than 5, indicating that the construct does not have any issues with multi collinearity. The above results are predicted in following Table.2 below.

Table 2: Convergent Validity

Variable	VIF	Alpha	Composite Reliability	AVE
CA	1.23	0.85	0.90	0.70
PSP	2.11	0.78	0.85	0.60
SPSS	2.91	0.87	0.92	0.75
TP	1.92	0.80	0.87	0.65
PCTMI	2.78	0.82	0.88	0.68
CC	2.34	0.86	0.91	0.73
OCP	1.34	0.88	0.93	0.76
OP	……	0.79	0.86	0.61

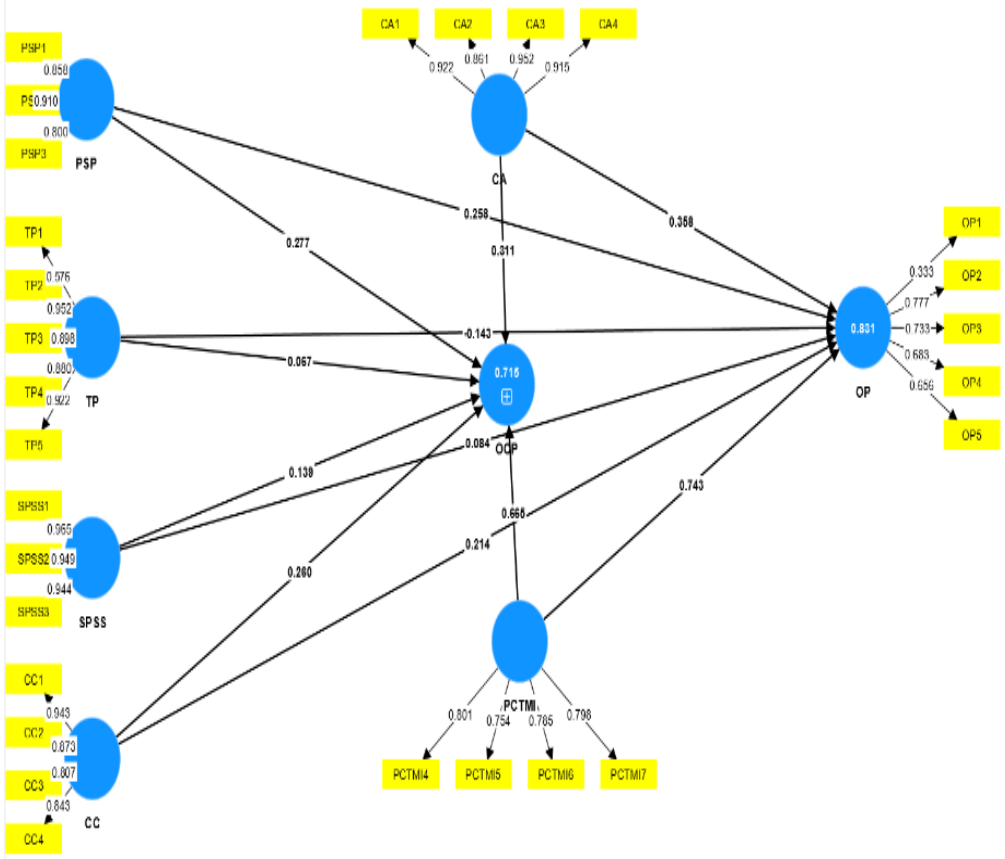

Figure 2: Factor Loadings

3.5 Discriminant Validity

Discriminant validity is a crucial aspect of the measurement model, and it can be evaluated using different criteria such as the Fornell and Larcker criterion, cross-loadings, and the heterotrait-monotrait (HTMT) ratio of correlations (Hair Jr et al., 2020; Henseler, Ringle, & Sarstedt, 2015). Based on the criteria mentioned, Fornell and Larcker found that the diagonal values were higher than the values below them

(Hair et al., 2017). Cross-loadings are used to determine if items primarily load higher on their designated constructs, indicating clear distinctions between constructs (Hair et al., 2017). Correlating two constructs using the geometric mean of each construct's AVE yields the HTMT ratio. A value that is near or below 0.85 suggests discriminant validity, indicating that the constructs are measuring distinct underlying concepts. When the HTMT ratio exceeds 0.85, it suggests the possibility of problems with discriminant validity, as noted by (Henseler et al., 2015). The values in Table 3 are below 0.85, suggesting that there is strong evidence of discriminant validity among the constructs.

Table 3: HTMT Results

	CA	PSP	SPSS	TP	PCTMI	CC	OCP	OP
CA	-							
PSP	0.65	-						
SPSS	0.55	0.60	-					
TP	0.60	0.55	0.58	-				
PCTMI	0.58	0.52	0.63	0.62	-			
CC	0.50	0.57	0.59	0.54	0.61			
OCP	0.48	0.61	0.52	0.59	0.53	0.34	-	
OP	0.52	0.58	0.60	0.57	0.55	0.78	0.58	

4. Hypothesis Results

Following model assessments, the subsequent step involves testing the research hypothesis. Prior to hypothesis testing, model fit in statistics pertains to the extent to which a statistical model accurately represents the observed data. The assessment evaluates the alignment between the relationships among variables in the model and the actual relationships observed in the data (Hair Jr et al., 2020; Henseler et al., 2015). The model's fitness can be evaluated using Q square and R square. Q square in PLS-SEM assesses the predictive ability of the model, while R square quantifies the proportion of variance in endogenous constructs that is accounted for by exogenous constructs. The metrics aid in assessing the model's predictive and explanatory capabilities (Hair Jr et al., 2020; Henseler et al., 2015). Cohen (1988)proposed that R square can be evaluated as substantial when it is 0.26, as moderate when it is 0.13, and as weak when it is 0.02. The R square values in Table 4 are 0.45 and 0.573, which are considered substantial. Moreover, values greater than 0 are deemed to have predictive relevance (Hair et al., 2017). All values in the construct are greater than 0, indicating its predictive relevance. The F square is commonly used as an effect size measure. Values of 0.02 or higher are considered small, 0.15 or higher are deemed medium, and 0.35 or higher are classified as large (Cohen, 1988). All values of F square are greater than 0.15, indicating that most variables have a medium level of impact on operational performance. The results of the PLS-SEM structural model indicate that all lean six-sigma drivers have a positive and significant impact on operational performance. The operations communication process has a positive and significant impact on operations performance. The results indicate that the communication process in operations significantly and positively moderates the relationship between lean six-sigma practices and operational performance in the service industry of Saudi Arabia. The above results are presented in Table.4.

Table 4: Model Fit and Hypothesis Results

Hypothesis	Beta	Standard Error	t-value	F square		Q Square	R Square
CA->OP	0.35	0.05	7.00***	0.32	OCP	0.332	0.452
PSP->OP	0.28	0.04	6.50***	0.19	OP	0.345	0.573
SPSS->OP	0.42	0.06	6.80***	0.20			
TP->OP	0.31	0.03	9.20***	0.36			
PCTMI->OP	0.19	0.02	8.50***	0.32			
CC->OP	0.36	0.04	8.00***	0.32			
OCP->OP	0.46	0.06	7.67***				
CA->OCP->OP	0.25	0.03	7.80***				
PSP->OCP->OP	0.29	0.05	5.60***				
SPSS->OCP->OP	0.38	0.06	6.20***				
TP->OCP->OP	0.33	0.03	10.00***				
PCTMI->OCP->OP	0.21	0.04	5.00***				
CC->OCP->OP	0.27	0.05	5.50***				

Note: p<10%=*, P<5%=**, P<1%=***

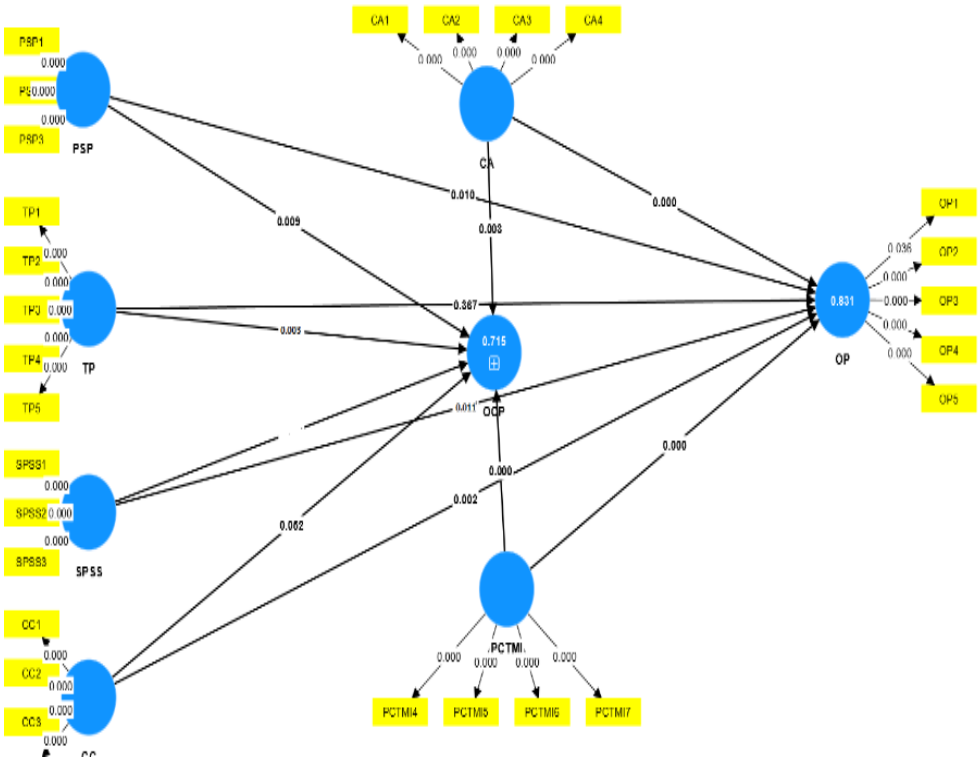

Figure 3: Structural Model (P values)

5. Discussion and Conclusion

The objective of this study was to examine the influence of success factors of six sigma on operations performance (OP) through the operations communications process (OCP) in the telecommunications industry of Saudi Arabia. The findings

indicate that communication and assessment practices (CA) in Lean Six Sigma initiatives have a significant impact on OP in the service industry of Saudi Arabia. The findings indicate that effective assessment and communication in lean six sigma can enhance operational performance in the service sector of Saudi Arabia. The findings are supported by previous studies Craveiro et al. (2023); Selvaraju, Bhatti, Sundram, and Abd Rahim (2019), which found a positive impact of transparent communication and assessment on operational performance. As a result, the study emphasizes the importance of robust corporate governance practices in promoting organizational performance in Saudi Arabia's service sector. Project management practices, including selection, prioritisation, and monitoring (PSP), have a significant and positive impact on organisational performance (OP) in service organisations in Saudi Arabia. The results indicate that strategic project management facilitates effective resource allocation, risk reduction, and alignment with organisational goals (Craveiro et al., 2023; Selvaraju, Bhatti, Sundram, & Abd Rahim, 2019). Therefore, it can be argued that efficient CA processes enhance collaboration, decision-making, and timely execution, ultimately resulting in improved operational performance. These findings are consistent with those of the study conducted by (Selvaraju, Bhatti, Sundram, & Abd Rahim, 2019).

Furthermore, the study demonstrates the substantial and favourable influence of project success stories, benchmarking, and best practices on the service industry in Saudi Arabia, as indicated by the results obtained from the SPSS analysis. The findings indicate that the use of SPSS in the Saudi Arabian industry is a significant factor in enhancing knowledge transfer and continuous improvement, as supported by (Selvaraju, Bhatti, Sundram, & Abd Rahim, 2019). The involvement of top management in organisations, known as participation and commitment of top management involvement (PSTMI), has a significant impact on organisational performance (OP) in the service industry of Saudi Arabia. The results indicate that involving employees in improvement initiatives enhances collaboration, empowers staff, and drives operational improvements. Aytekin et al. (2023) have shown that employee involvement has a positive impact on performance. The cultural change (CC) in LSS projects has a positive and significant impact on operational performance. The study by Aytekin et al. (2023) demonstrates that fostering a cultural shift towards continuous improvement and innovation improves employee morale, productivity, and organisational adaptability. The Operations Communication Process (OCP) has a significant and positive impact on OP.

The results of the indirect effect indicate that the frequent use of Lean Six Sigma in the Saudi Arabian service industry has a positive and significant impact on OP. This impact is mediated by OCP. The findings indicate that implementing a comprehensive assessment enables organisations to effectively track progress, pinpoint areas in need of improvement, and promptly address operational challenges. By fostering a culture of transparency and accountability, service providers in Saudi Arabia can improve OP. Moreira, Nascimento, Smirnova, and Santos conducted a study in 2024 and found a positive correlation between transparent CA and OP. Thus, these findings indicate that efficient CA mechanisms allow organisations to synchronise Lean Six Sigma initiatives with strategic objectives, foster ongoing improvement, and provide exceptional services to customers, ultimately enhancing their competitive edge in the global market. In the service industry of Saudi Arabia, it was discovered that monitoring PSP had a notable and beneficial influence on OP. This effect was observed to be mediated by OCP.

The findings indicate that the implementation of strategic project management practices, coupled with effective communication, allows organisations to prioritise initiatives, allocate resources efficiently, and closely monitor project progress. This ultimately leads to improvements in operational performance. The finding aligns with the research conducted by Achibat, Lebkiri, Lougraimzi, Berrid, and Maqboul (2023) and Moreira, Nascimento, Smirnova, and Santos (2024), highlighting the significance of project management in fostering operational excellence and achieving project success in service organisations. Integrating project management and communication strategies is crucial for aligning with organisational goals and enhancing stakeholder engagement. This, in turn, leads to improved sustainable growth and success in the service sector.

Moreover, The use of SPSS has been found to have a positive and significant impact on organisational performance in the service industry of Saudi Arabia, with the mediating effect of organisational commitment on organisational performance. The findings indicate that by sharing successful project experiences and adopting best practices, the service industry in Saudi Arabia can effectively communicate and disseminate valuable insights. This allows for the replication of successful strategies, leading to improved OP. These findings align with the research conducted by Liu et al. (2024), which emphasises the importance of knowledge sharing and benchmarking in driving operational excellence through Lean Six Sigma initiatives. On the other hand, The study revealed that TP had a significant positive influence on OP, with the mediating effect of OCP. The results indicate that comprehensive TP enhance employees' skills, knowledge, and tools, resulting in increased communication channels in the service industry of Saudi Arabia and ultimately leading to improved operational performance. Therefore, one could argue that the integration of TP fosters a culture of ongoing learning, empowers employees to contribute to organisational objectives, and improves overall OP. This finding aligns with the research conducted by Aytekin et al. (2023), which demonstrated the positive influence of comprehensive TP on operational effectiveness and innovation capabilities.

The findings indicate that OCP plays a significant and positive mediating role in the relationship between PCTMI and OP in the service industry of Saudi Arabia. The findings indicate that involving employees in improvement initiatives fosters collaboration, empowers staff, and enhances operational performance. This is supported by Aytekin et al. (2023), who conducted a study demonstrating the positive impact of employee involvement on OP. Promoting an environment of continuous improvement and innovation has been found to enhance employee morale, productivity, and organisational adaptability. The findings are consistent with Aytekin et al. (2023) research, which emphasises the strategic significance of cultural transformation in promoting operational excellence and organisational success in dynamic market environments. Furthermore, the study revealed that CC in lean sigma projects has a positive and significant impact on OP in the Saudi Arabian industry, with the mediating effect of OCP. The findings indicate that adopting a culture of continuous improvement and innovation enhances employee engagement and collaboration, leading to improvements in OP within the service industry in Saudi Arabia. Based on previous research, it can be concluded that the service industry in Saudi Arabia places significant emphasis on critical factors related to Lean Six Sigma. This focus is primarily aimed at enhancing the communication process within operations, ultimately leading to improved operational performance.

6. Implications and future directions

The study has theoretical and practical implications that are derived from empirical findings. The study contributed significant findings that enhance our understanding of the role of operational communication processes in Lean Six Sigma initiatives, specifically in improving operations performance in the Saudi Arabian service industry. The current study examines how effective communication channels contribute to the implementation and success of operational improvement initiatives by introducing the concept of operations communication as a mediator. This emphasises the importance of considering not only the technical aspects of Lean Six Sigma or project management but also the communicative processes that support these initiatives. Hence, the acknowledgment of operations communication serves as a mediating variable that plays a significant role in connecting strategic planning and operational execution. Moreover, this study has contributed to the existing literature on the service industry in Saudi Arabia. The findings of this study can be beneficial for researchers in other developing nations who wish to conduct research using an extended model.

In addition, the study outcomes provide valuable insights for service organisations in Saudi Arabia aiming to improve operational performance through Lean Six Sigma initiatives. Practitioners can prioritise efforts to establish clear and transparent communication channels throughout the project lifecycle by understanding the mediating role of operations communication. Implementing communication protocols and fostering a culture of open dialogue and feedback exchange among stakeholders may be necessary. Organisations can enhance project success by acknowledging the importance of effective communication in operations and investing in training programmes to equip employees with the necessary skills. This will help ensure alignment with organisational objectives. Integrating communication strategies into project management practices can help organisations mitigate risks, optimise resource allocation, and improve decision-making processes. This can ultimately lead to sustainable improvements in service quality and operational efficiency.

The study has produced significant results, but it also has limitations that should be addressed in future research to explore new areas of study. For example, this study focuses exclusively on the service industry in Saudi Arabia and does not consider other manufacturing industries, which limits the generalizability of the findings. Hence, further investigation should be conducted to examine the variations in findings across different sectors or countries. Further investigation is currently restricted to the use of cross-sectional research design, which involves collecting data at a single point in time. Therefore, future research should consider utilising a longitudinal research design, which allows for data collection at multiple time points. The current study focuses primarily on the mediating effect, neglecting other potential moderating variables such as demographic factors (age, gender, income). Incorporating these variables could enhance the predictive validity of the study.

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Appendix A: Survey Instrument

	1	2	3	4	5
Communication and assessment					
Use of LSS problem-solving tools/techniques to solve problems					
Good communication between different departments					
Effective top down and bottom-up communication					
Clear, consistent communication of mission statement and objectives in your unit					
project selection and assessment					
Having project selection and prioritization on projetc.t improve company competitive advantage, business profitability etc.					
Periodic project review to ensure projects are proceeded according to schedule.					
Project tracking system to track the project status.					
sharing of project success stories					
Extent to which LSS data (cost of quality, errors etc.) are used as tools to manage LSS performance					
Extent to which LSS project success stories and best practice are available to employees					
Extent to which LSS project success stories and best practice are available to managers and supervisors					
Extent to which LSS project success stories and best practice are displayed at employee work place					
Training programs					
Specific LSS training (yellow, green, black belt) given to employees throughout the company					
LSS awareness training among employees is ongoing					
Training in statistical techniques (histogram, control charts, etc.)					
Availability of resources for employees training in company					
Training in interactive skills (communication, leadership, meeting skills)					
Participation and commitment of top management					
Clearly promotes the direction, vision and core values of the company					
Supports and actively participates in the activities of the LSS projects (training, project selection, review and evaluation of results of each phase					
Takes responsibility for the operation of the LSS projects.					

Encourages staff participation in the implementation of LSS projects
Communicates the mission and objectives of the company clearly and consistently
Provides materials and supplies to the work team so that they can carry out the LSS project
Maintains goals to improve their quality performance
Cultural Change
Understand and are committed to the vision, values and quality objectives of the company.
Share a high degree of commitment to make the company's strategies a reality.
Have a sense of belonging to the company, so they do not see themselves as just employees.
Consider that their opinions are taken into consideration when implementing new ideas.
Operations Performance
Company has the ability to swiftly introduce new services to the market
Company displays agility in responding to market demand changes
Company maintains an exceptional on-time delivery record to major customers
Company offers a superior level of customer service to major client
Company has the ability to swiftly introduce new services to the market
Company has the ability to swiftly introduce new services to the market
Operations Communication Process
Maintain a strong and open communication channel
Company communication mode is cost effective
Share the project results and learn from them
Share the project results and learn from them
Hold regular business meetings to communicate and discuss issues effectively"