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The Prevalence of Six Sigma Trends in the Construction Industry in Pakistan

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THE PREVALENCE OF SIX SIGMA TRENDS IN THE CONSTRUCTION INDUSTRY IN PAKISTAN

A Thesis
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The Faculty of the Department of Architectural and Manufacturing Sciences
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Master of Science

By
Muhammad M. Hassan

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THE PREVALENCE OF SIX SIGMA TRENDS IN THE CONSTRUCTION INDUSTRY IN PAKISTAN

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I dedicate this thesis to my beloved father, Nazar Hussain, who has been my strength and inspiration. I am thankful for his unending support, motivation, love and faith in me. I am grateful to my mother, siblings, and my wife for their prayers and support.
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Economic development in any country or area depends heavily on the performance of the construction industry. This is because the subsequent development of infrastructure increases economic activity, living standards, direct foreign investments, and business opportunities. The construction industry in Pakistan also plays a significant role in its economic activity, and the government’s focus towards increasing infrastructure development provides the construction industry with growth prospects. It is observed that quality management practices in the Pakistan construction industry are highly inadequate to enhance quality. The construction industry there is highly challenged with inadequate delays in projects and project quality. The need for the implementation of Six Sigma in the construction industry in Pakistan is underestimated. The structured questionnaire has been developed to collect data from a sample size of 100 managers from 100 construction companies in Pakistan. Current study determines the current trends, the extent of implementation, prior knowledge and related training required in the implementation of Six Sigma.
Introduction

Background of the Study

The construction industry played a prominent role in uplifting the national economy. The development of efficient infrastructure promoted productivity and generated employment. However, the cost related to construction projects was high due to the prevalence of heavy machinery, workforce, and capital requirements. The construction industry ensured the construction of innovative and efficient infrastructure in a cost-efficient manner to achieve the economic objectives. Similarly, the business prospects for the construction industry could be enhanced by means of economic growth and business prospects (Lawson, 2013).

The business sector was highly dependent on the performance of the construction industry because the construction industry ensured the availability of roads, telecom networks, dams, power stations, and railway structure. This eventually made the country feasible for foreign investors. Moreover, the construction industry also enhanced the development of real estate by means of providing the availability of well-structured houses, which led towards urbanization and increased the population. It provided businesses with the availability of the local population at such locations, which made it highly feasible to consider business expansion and provide access to the local market (Zou & Chau, 2014).

Infrastructure development led towards the economic activity by means of generating employment, foreign and local investments, increase in per capita income and gross domestic product (Zou & Chau, 2014). However, considering the capital
requirement in the construction industry, effective quality control strategies, comprised of Six Sigma, could help in reducing the capital requirement and resource consumption in construction projects (Snee, 2010). Therefore, it could contribute to increasing the extent of infrastructure in the country and could lead towards economic stability.

The implementation of quality enhancing procedures required support from the organization and departments by means of integrating implementation procedures with the organizational culture and policies. Six Sigma was considered an effective means of incorporating improvement methods and techniques in the organization to ensure sustainable success. It also focused on addressing the needs of customers and helped in conducting an empirical analysis to determine inefficiencies in the work processes. It also ensured continuous improvement by reinventing the business processes (Snee, 2010).

Implementation of Six Sigma in the organization required the effective training of employees. Similarly, employees should possess a strong inclination towards the achievement of project outcomes that were developed in accordance with Six Sigma. The implementation of Six Sigma was dependent on the organizational and managerial support to achieve the organizational objectives. It eventually indicated that the implementation of Six Sigma should be implied at the organizational level so that the respective departments could develop competitive teams, acquire resources and organizational support to carry out work processes designed in accordance with the Six Sigma practices (Pepper & Spedding, 2010).

Management students, trainees, and construction consultants should be equipped with the latest information about the implementation of Six Sigma practices in construction projects. This would have ensured an increase in quality and would have
incorporated continuous improvement in the overall projects. In this instance, Pakistan Institute of Quality Control (PIQC) was addressing the educational need of the consultants and management professionals, and it aimed to provide training and certifications in quality management programs. Moreover, PIQC offered specialized training in Six Sigma to enhance the skills of potential consultants. It equipped the project consultants with efficient quality management practices and offered green, yellow and black belt Six Sigma certifications (PIQC, 2016).

Six Sigma could help in enhancing the work processes in the construction industry and could improve the skills of employees, which was also an antecedent for the effective implementation. However, it was required to know the current trends in Six Sigma in the construction industry, because the knowledge about Six Sigma prevailed among the management as it has been a part of the professional and academic curriculum for over a period of 15 years (PIQC, 2016). In this instance, the knowledge of current trends in Six Sigma could help in identifying the extent to which strategic implementation of formal Six Sigma was required to be implemented in the construction industry.

Pakistan was the 38th largest country based on its gross domestic product (GDP) and was ranked 25th in purchasing power parity. It was the 6th largest country in terms of population and accounted for over 190 million in population. The GDP of Pakistan was estimated to be $285 billion dollars with the purchasing power parity of $982 billion in the year 2016. The economic growth rate was observed to have a positive trend, with the average growth rate of 4.91% since 1952 (Trading Economics, 2016a). The current government has developed attractive policies for direct foreign investments in the
country, which resulted in 4.8% increase in foreign direct investment. Foreign private investment accounted for $1666.2 million in the year 2015, which indicated the prevalence of a greater extent of economic activity in the country (GoP, 2015).

The positive trend in the economy was considered to be the result of the government’s macroeconomic policies and structural reform programs that resulted in decreased oil prices and better investment prospects, which in turn increased the return on investments and attracted local and foreign investments in the country (Trading Economics, 2016a). The foreign direct investment in Pakistan was found to be $751 million in the year 2016, which resulted in enhanced economic prospects in the country and broader business opportunities in the construction industry (Trading Economics, 2016b).

**Statement of the Research Problem**

The Pakistani GDP was made up of 20.9% contribution from the agriculture sector, 20.3% from the industrial sector and 58.8% of the service sector (GoP, 2015). Moreover, the construction industry of Pakistan contributed 12% to the total GDP in the year 2015 and witnessed a growth rate of 7.05% for the preceding year (GOP, 2015). It eventually indicated that development of infrastructure in the country by means of incorporating economic activity in the construction industry increased significantly.

The forecasted growth in GDP was expected to be 4.5% for the year 2016 but turned out to be 4.7% for that year. The economic growth was estimated to be 5.7% by year 2017 (Trading Economics, 2016a). The extent of gross domestic product and foreign direct investment indicated the need for infrastructure development in the country in order to support the growing economic activities. It increased employment opportunities
and provided economic stability by providing business potential to the firms that encompass horizontal and vertical integration (Haseeb et al., 2011).

The government of Pakistan launched a ‘Hunarmand Pakistan Program,’ which focused on providing skill development opportunities to citizens in construction, agriculture and information technology (GoP, 2015). Pakistan acquired a skilled workforce in the construction industry, which eventually indicated strong economic prospects in the construction sector. Pakistan then had the potential to become one of the largest economies in the twenty-first century due to the increasing rate of gross domestic product and economic potential (Haseeb et al., 2011).

The development of infrastructure and efficient means of capital utilization were considered a major challenge to Pakistan. It was estimated that the country needed a total investment of $150 billion in order to meet the exceedingly high growth of population by the year 2018 (SBF, 2013). In order to cater to such an increasing population, approximately 300,000 housing units were needed to satiate the accommodation demand (GoP, 2015). Therefore, construction firms were required to become efficient by means of enhancing quality and cost reduction to meet the national objectives with the effective implementation of Six Sigma in construction work processes.

The construction industry of Pakistan provided strong financial prospects for investors; however, it also faced operational challenges by means of construction delay in the projects. The prevalence of delays in construction projects increased the operational costs and reduced profitability by means of increased labor cost and duration. The scarcity of power and electricity in the country also required adequate planning that could ensure the efficient use of organizational strengths in an effective manner. The
construction industry focused on the acquisition of technological advancements to ensure efficiency in the construction projects (Haseeb et al., 2011).

Pakistan lacked the number of consultants and professionals who were adept at Six Sigma, which reduced the construction firms’ inclination towards the implementation of Six Sigma. The prevalence of quality management in construction firms was found to be stagnant due to the anecdote that incorporated quality management as a manufacturing or operational concern (Zhang et al., 2012). Organizations’ management in the construction industry was focused towards enhancing profitability by means of employing cost reduction strategies, maintaining quality standards and following traditional quality assurance practices.

Pakistan’s focus towards continuous development in infrastructure had created business opportunities in the construction industry. Growth prospects in construction industry required effective utilization of time, money and resources to meet organizational and national objectives. It was essential that the current trends in Six Sigma be implemented in accordance with the practical understanding of these trends in the construction industry of Pakistan. Moreover, it was required that the extent of knowledge about Six Sigma, firms’ intention, and capability to implement Six Sigma in the construction industry of Pakistan be examined. Therefore, this study determined the knowledge, intention, and capability required to implement Six Sigma in the construction industry of Pakistan in order to propose effective implementation strategies for Six Sigma.
**Significance of the Study**

The economic development in Pakistan was highly dependent on the productivity of the construction industry. It was the prevalence of infrastructure work such as flyovers, dams, bridges, buildings, residential schemes and power generating facilities, that increased the employment rate in the country. It also attracted foreign and local investors to support their business operations in the country with the availability of infrastructure to facilitate the business prospects. The increase in employment rate affected the per capita income of the country and resulted in the cycle of economic development in the country (Zou & Chau, 2014).

Six Sigma provided an effective means to identify inefficient work processes that caused delays and hindrances in projects and could fix the problems in order to enhance the overall quality. The government’s focus on infrastructure development required the construction industry to become efficient to meet the national economic development objectives in an effective manner (SBF, 2013). Therefore, research in engineering and quality management was required in the construction industry of Pakistan to determine the prevalence of current trends in the implementation of Six Sigma.

The construction industry in Pakistan needed to understand the significance of adopting quality management practices to ensure productivity and profitability of enhanced quality. Moreover, government delegates required a more extensive exposure to the quality management practices that could contribute to the achievement of national economic objectives (Haseeb et al., 2011). There was also a need for construction firm management to understand the significance of quality practices such that the implementation mechanism could be delegated effectively in firms. It could help in the
development of formal quality standards at the national level to implement quality management principles.

Lack of formal regulations to incorporate the implementation of quality management practices also hindered the firms' potential to take proactive measures in the implementation of such practices (Shah et al., 2016). Therefore, it was also necessary that concerned authorities understand the significance of quality management practices in the construction industry in order to develop formal regulations. Moreover, management in the construction firms also needed to understand the importance of such practices at an organizational and national level so that they could develop adequate implementation plans and adopt the formal quality standards (Zhang et al., 2012).

Therefore, the prevalence of a formal quality standard at the national level would encourage construction firms to consider the implementation of Six Sigma in the work processes because Six Sigma focused on enhancing quality by means of incorporating process efficiency. In this manner, focus towards the implementation of Six Sigma would take place when the significance of effective management frameworks for construction projects was determined.

**Purpose of the Study**

The current study aimed to understand the attitude of managers towards Six Sigma in the construction industry in Pakistan. It helped to understand the readiness of construction firms to implement the Six Sigma mechanism in the work processes. Similarly, the study indicated the extent to which Six Sigma has been involved in construction companies by means of determining prior knowledge of Six Sigma in the organization. This study also aimed to highlight the current extent of knowledge
prevailing among the construction professionals about the effective utilization of Six Sigma.

This research enlightened management and stakeholders in the construction industry about the significance of Six Sigma. In this way, this study provided managerial implications on enhancing the knowledge, skills, and abilities of employees by means of effective training and development for the effective implementation of Six Sigma. It effectively helped in determining the extent to which construction companies understood the effectiveness of Six Sigma in the work processes.

Moreover, the current study intended to identify needs of construction companies wanting to implement Six Sigma in work processes. This study was objectified to enlighten the dearth of requisite knowledge among the construction professionals required to implement Six Sigma. Therefore, this study ascertained the prevalence of Six Sigma knowledge and adequate training needs that were necessary to be applied in the construction industry of Pakistan.

Research Questions

The current study propounded the following research questions:

RQ1: What were the current trends in Six Sigma in the construction industry in Pakistan?

RQ2: How adequately had Six Sigma been implemented in the construction industry in Pakistan?

RQ3: What was the extent of adequate knowledge of Six Sigma in the construction companies in Pakistan?
RQ4: To what extent did construction companies want to implement Six Sigma?

RQ5: Were construction companies aware of the effectiveness of Six Sigma in Pakistan?

RQ6: Was Six Sigma knowledge and training required in Pakistan for its practical application in the construction industry?

**Assumptions**

The assumptions in this research study addressed the beliefs and ideas that the researcher considered significant in shaping the direction of the study. However, these assumptions lacked factual knowledge and could have hindered the validity of the research. The assumptions incorporated in this study were as followed:

1. Managers in construction companies were able to provide an informed opinion about the prevalence of Six Sigma.

2. The quality of training and development regarding Six Sigma in Pakistan was considerably similar to the extent of training and development regarding Six Sigma in the United States.

3. Construction companies in Pakistan could implement Six Sigma standards and practices in an effective manner.

4. Management in the construction industry of Pakistan had prior information about Six Sigma in order to determine its trends and inclinations to implement by means of perceived effectiveness of Six Sigma.

5. Managers responded without any bias.
6. Managers shared information about business operations in an effective manner.

Limitations and Delimitations

The current study had the following limitations:

1. The current study evaluated the construction industry in Pakistan. Hence, it did not provide any research implications or empirical understanding of the current trends in Six Sigma in any other industry.

2. The study utilized the quantitative approach for the collection of data by means of measuring the prevalence of Six Sigma practices on a scale and did not encompass a qualitative approach to provide extensive insights about the trends in Six Sigma.

3. Structured, closed-ended questions acquired the data. Hence, the current study did not provide insights about the inclinations of managers towards their responses due to a lack of open-ended questions.

4. The current study was focused on inclinations of middle managers in the construction industry and did not address inclinations of top management in the construction industry.

5. The researcher only considered three major areas; Lahore, Karachi / Hyderabad, and Islamabad / Rawalpindi for this research.

Definition of Terms

Total Quality Management
The effective administration of work processes to sustain quality standards. It addresses policy, planning, assurance, control and improvement in the effective maintenance of quality in the work processes (Memon et al., 2013).

**Six Sigma**

The systematic approach that is focused on eliminating the prevalence of defects from the work processes (Banawi & Bilec, 2014).

**DPMO**

Acronym for defects per million opportunities (Banawi & Bilec, 2014).

**DMAIC**

Define, measure, analyze, improve and control (Aboelmaged, 2010).

**DFSS**

Design for Six Sigma. It is comprised of mainly five stages including define, measure, assess, design and verify (Aboelmaged, 2010; Banawi & Bilec, 2014).

**DCOV**

When DMAIC is applied to the construction industry is converts to DCOV standing for definition, characterization, optimization and validity (Tchidi et al., 2012).
Review of Literature

This section of the study aims to search scholarly articles to determine the prevalence of Six Sigma and Quality Management Practices and their significance in business prospects. The context of Six Sigma in the construction industry and prevalence of Six Sigma in Pakistan are also discussed in accordance with prior scholarly research. Moreover, the context of training and development for effective implementation of Six Sigma and barriers in its implementation are illuminated by addressing the findings of prior studies.

Six Sigma and Quality Management Practices

Improvement in work processes was required to increase the efficiency of work processes and achieve a positive bottom-line. The quality of products and services offered by the company provided a competitive advantage and enhanced business profitability. Strategic decisions related to quality enhancement required the implementation of quality control practices that ensured process improvement and consistent quality throughout the work processes. The significance of such practices was considered prominent in the business sector regardless of the type of industry because it focused on enhancing the financial prospects and the quality of products and services (Pepper & Spedding, 2010).

Six Sigma accounted for statistical means of identifying the prevalence of defects in the work processes. In this instance, it helped in teaching a systematic approach that led towards process improvement. It was implied that Six Sigma provided a structured approach to ensure the prevalence of process improvement, which incorporated an outline addressing the sequence of define, measure, analyze, improve and control. Each sequence
indicated process control, experimental design and response methodology to provide the organizations with financial and operational benefits. It also provided effective means of measuring, analyzing, and improving critical procedures so that production mechanism could be under control and provided optimum output (Tjahjono et al. 2010).

Sigma addressed the inconsistency in incidents by means of enlightening the variance in the overall process. Six Sigma represented the benchmark statistics that indicated the presence of 3.4 defects per million opportunities, also known as DPMO. Six Sigma was introduced and implemented by General Electric and Motorola in the early 1980s, where it was considered an effective management tool to reduce the number of defects in production. It was implemented in the production processes of General Electric and Motorola; however, both companies utilized Six Sigma in order to achieve different business objectives (Banawi & Bilec, 2014).

The effective implementation of Six Sigma helped Motorola, which was focused on ensuring long-term business prospects, helped the organization to save 14 billion dollars over a period of ten years. Similarly, General Electric, which was focused on retaining its market share, successfully increased its sales by 1.5 billion dollars during a course of one year. It eventually indicated the effectiveness of implementing Six Sigma in business operations in order to achieve business objectives. After its evidence of success in Motorola and General Electric, strategic implementation of Six Sigma had been applied in several industries to achieve the organizational objectives (Banawi & Bilec, 2014).

Six Sigma was considered the mechanism of process improvement which contained breakthrough processes which applied the focus towards continuous
improvement. It was an effective means of strategy that could help in reducing the extent of defects in the overall work processes. Six Sigma focused on reducing the number of defects that could be as low as 3.4 incidents out of million incidents. In this manner, Six Sigma encompassed the development of a structured methodology that helped in the evaluation of the work processes and identification of hindering and time-taking tasks. It also supported problem-solving mechanisms in order to address hindering factors and replaced work processes with efficient tasks (Aboelmaged, 2010).

Six Sigma was incorporated at a strategic level, which eventually depicted that it was integrated with the business strategy of the organization to ensure the integration of business activities with quality enhancement mechanism. It focused on exceeding the extent of quality standards in the organization and was found to be applicable in the manufacturing and service sectors. The structured approach of Six Sigma incorporated DMAIC to design such processes that ensured elimination of errors and defects by means of definition, measurement, analysis, improvement and control of operations. The effective implementation of Six Sigma reduced the number of work cycles, increased product quality, provided cost and time efficiency, ensured profitability and increased market share (Ismyrlis & Moschidis, 2013).

The effective implementation of Six Sigma required a top-down approach, in which the management of the organization was required to delegate and embed the Six Sigma practices among the employees and work process. In this instance, effective participation and commitment of management were required to increase the overall quality of work processes. Moreover, development of performance metrics was also essential to the management for quality enhancement mechanism, in which the current
extent of delays or defects in a million incidents, defects per unit and rolled throughput yield was determined. It helped in determining the effectiveness of Six Sigma practices by means of measuring the organizational performance. It also provided the management with improvement prospects when performance objectives of the organization were underachieved (Aboelmaged, 2010).

Critical factors were required to be addressed in order to ensure the effective implementation of Six Sigma, in which pre-requisite commitment and participation of management were essential. Committed management supported the implementation mechanism throughout the business stages and incorporated the cultural change in the organization. In this instance, the development of organizational philosophy, values, and culture was required to be directed towards the effective adoption of Six Sigma practices. The effective utilization of statistical tools was also required to monitor the effects of Six Sigma implementation and to integrate the results with the financial performance of the organization (Ismyrlis & Moschidis, 2013).

Six Sigma accounted for two types of application mechanism, i.e. DMAIC and DFSS. The implementation of DMAIC focused on define, measure, analysis, improvement and control, and it helped in enhancing the efficiency of the work processes that already existed in the organization. However, it was essential that existing work processes could divide into these phases in order to ensure the effective application of Six Sigma. Prior researchers had indicated the effectiveness of DMAIC application mechanism in healthcare organizations, manufacturing industries and financial and auditory organizations (Aboelmaged, 2010).
DFSS was useful for designing new work processes, especially when existing work processes failed to provide adequate results. DFSS mechanisms also accounted for five stages, mainly comprising of define, measure, assess, design and verify the work processes. In this instance, DFSS application of Six Sigma could be applied in a high-tech manufacturing industry and was considered as an effective means to design new processes while keeping processes innovation costs low (Aboelmaged, 2010; Banawi & Bilec, 2014).

**Six Sigma and Business Prospects**

Business objectives focused on the achievement of a positive bottom-line, due to which organizations tended to improve business strategies so that the financial prospects could be enhanced. The strategy that accounted for business improvement was considered as an historical notion, in which business processes were analyzed, improved and evaluated in order to achieve positive financial outcomes. In this instance, Six Sigma was considered as a most conventional approach to business improvement in which analysis, evaluation, improvement, and control of business processes took place and effectively contributed to the achievement of financial objectives (Snee, 2010).

Six Sigma accounted for increased business performance and provided a greater extent of customer satisfaction, and was also recognized as a management and leadership tool. It was implied that Six Sigma strengthened the leadership of the organization by means of equipping the leadership with an efficient mechanism of problem solving techniques. Leadership and management incorporated effective planning, organizing, leading, influencing, controlling, and evaluating, whereas Six Sigma ensured that the
work processes were planned according to demand, efficiently organized, controlled and evaluated in order to meet the work objectives.

Similarly, organizations were inclined towards addressing the needs of customers by means of an effective delivery mechanism, cost efficiency, and high quality. The context of improvement in Six Sigma ensured that ever-changing customer needs were addressed, and adequate controlling factors ensured the prevalence of cost-efficiency. Moreover, the context of control in Six Sigma enabled organizations to determine and eliminate hindering factors from work processes and ensured an efficient extent of the delivery mechanism. The quality of services was bound to increase when delivery mechanism and work processes were efficient and addressed needs of customers. In this instance, Six Sigma provided a systematic procedure to determine the effect of the process improvement mechanism on business performance and hence, could provide valid and significant results for improvement and continuous growth.

The study conducted by Snee (2010) showed financial prospects of business in accordance with the implementation of Six Sigma, in which it was observed that Six Sigma ensured 1% to 2% increase in sales in large organizations, whereas it incorporated 2% to 3% increase in sales in medium to small organizations. Similarly, that percentage of sales resulted in a significant increase in profitability. For example, an organization that had profitability of $1 billion on a yearly basis, increased its profits by $30 million after the implementation of Six Sigma - a 3% increase per annum. Hence, the profitability of the organization continued to increase by 3% on a yearly basis, and the organization experienced profits of $60 million and $90 million in the second and third year, respectively (Snee, 2010).
Six Sigma practices were highly dependent on the support of top management and business leadership in order to develop organizational strategies that addressed continuous improvement mechanism. Six Sigma also focused on enhancing customer relationship with the organization so that the organization could understand customer needs and the extent of customer satisfaction. Key customers were able to determine quality concerns that hindered their level of satisfaction, and hence, the organization could incorporate Six Sigma mechanism to address those concerns in an effective manner (Zu et al., 2008).

The business prospects were also found to be highly integrated with suppliers because they played a prominent role in ensuring the quality of material provided for further operations. Similarly, the efficiency of suppliers could reduce project delays in the construction industry. Six Sigma developed evaluation mechanisms, which ensured that suppliers were evaluated on the basis of quality and efficiency so that value chain of the organization could be strengthened. Moreover, the flow of Six Sigma practices from one organization to supplier was also facilitated by the Six Sigma mechanism, in which suppliers were enlightened with the effectiveness of Six Sigma, and were persuaded and assisted in ensuring the implementation of Six Sigma practices (Zu et al. 2008).

The construction mechanism was comprised of various activities and work processes that took place simultaneously and were interdependent. In this instance, effective scheduling of work processes was required so that interdependent procedures were not delayed due to delay in prerequisite activities. Six Sigma ensured that mistake-proof work processes were practiced in the organization that ensured time efficiency. In this instance, Six Sigma incorporated an adequate means of process control so that
inadequate delay and excessive wait in interdependent activities could be reduced. It eventually required effective integration between suppliers, managers, and employees so that resources were procured and utilized in an effective manner (Zu et al., 2008).

Six Sigma was contemplated at an organizational level, which eventually indicated its delegation in overall departments of the organization. In this instance, it ensured that employees were rewarded, appraised and trained in accordance with the Six Sigma practices by human resource department. Similarly, it also made sure that procurement department managed inventory and heavy machinery in such a manner that it reduced waiting time and inadequate delays (Snee, 2010).

Moreover, the marketing department ensured that customer relations were managed and potential customers were targeted according to the quality offered by the organization. Whereas, finance department ensured that adequate resources were available to carry out the work process without unnecessary delays. Similarly, information technology department provided management with an effective means of dashboard Six Sigma monitoring mechanism so that performance of employees and individual construction projects was monitored in an effective manner (Zu et al., 2008).

Managers tended to measure the performance of Six Sigma practices via quantitative metrics that addressed organizational objectives, performance objectives, and team objectives. Quantitative metrics were focused on determining the overall quality of work processes in order to determine the efficiency of Six Sigma practices. Prevalence of quantitative metrics ensured inclusion of qualitative factors in which the extent of customer satisfaction and expected performance were also addressed. Quantitative metrics ensured that every aspect contributing to quality enhancement and process
efficiency was addressed and hence, it provided holistic results to the organization (Banawi & Bilec, 2014).

Work practices incorporated by Six Sigma were implemented in work teams, whereas it provided management with the ability to determine their performance at the team, as well as, at the individual level (Tchidi et al., 2012). Furthermore, it determined the monetary value of performance and provided adequate rewards and quantifiable extent of performance to employees. It eventually motivated them, developed a healthy intra-group competition, and increased the overall performance of the organization. Availability of technological advancements in data mining and statistical analysis ensured that data related to the project completion and project objectives was collected and measured. It eventually provided management with extensive information in order to carry out adequate decisions related to improvement in work processes (Tchidi et al., 2012).

Effective prevalence of decision making and problem solving was required to achieve organizational objectives. However, issues and concerns in work processes were often unknown, and management was most likely to be unaware of those concerns. Six Sigma ensured that development of innovative solutions for unknown concerns and provided the organization with the opportunity to carry out work processes with efficient solutions. Six Sigma had the potential to achieve work-related objectives with innovative solutions and increased managerial inclination towards the achievement of efficient work processes. Six Sigma reshaped organizational environment, eventually fostering prevalence of organizational focus towards continuous improvement (Banawi & Bilec, 2014).
Business prospects of organizations decreased when work processes were highly bureaucratic in nature due to inadequate delays caused by extensive procedures. Availability of Six Sigma professionals in organization initiated change in the hierarchical framework and reduced inadequate bureaucratic work processes. Work designs developed in accordance with Six Sigma practices prevailed in developed countries and multi-national organizations (Antony, 2004). It provided construction industry in Pakistan with a head start to replicate operational models from the multinational organization, by means of implementing, analyzing and improving the operational models in accordance with results of an implemented process design.

Effective implementation of Six Sigma was highly dependent on objectives related to customer satisfaction, cost efficiency, time efficiency, managerial commitment, employee training, and available resources. It was required that projects, where Six Sigma was implemented, were extensively reviewed in accordance with their need for improvement. Otherwise, implementation of Six Sigma could incorporate negative results. It eventually indicated risks related to the implementation of Six Sigma in the organization. In this instance, it was suggested that cost-benefit analysis was conducted before implementation of Six Sigma mechanism and projects should be prioritized on the basis of their need for improvement. Similarly, integration of top management and strategic objectives of the organization was required so that policies and implementation plans could be delegated in the organization in an effective manner (Banawi & Bilec, 2014).

Organizations also tended to implement Six Sigma practices by merging its elements with prevailing quality enhancement mechanisms. These quality enhancement
mechanisms incorporated the total quality management practices. However, the organizations needed to understand that prospects and effectiveness of Six Sigma and total quality management varied because Six Sigma provided the organization with an opportunity to measure the effectiveness of Six Sigma in internal, as well as external context. It was also observed that Six Sigma was inclined more towards profitability than any other quality management practices, which eventually indicated positive financial prospects on its implementation (Antony, 2004).

Solutions proposed in accordance with Six Sigma practices were highly cost-efficient and focused on the development of employees, managerial integration, and customer satisfaction. In this manner, Six Sigma provided a holistic approach to its implementation, assessment, evaluation, and improvement in the organization while ensuring achievement of business objectives. Correlation results indicated the empirical prevalence of association between Six Sigma and profitability, which eventually provided financial prospects to organizations. Moreover, Six Sigma assured decrease in process variations, decrease in the extent of defects and inspection duration. Similarly, it also proved to be effective in reducing the capacity cycle duration and promoted efficient inventory management, which eventually led towards effective delivery mechanism (Banawi & Bilec, 2014).

Capital costs were found to be decreased, whereas profitability of the organization increased with increased sales and quality services with the implementation of Six Sigma. However, it was essential to determine appropriate projects where Six Sigma was required to be implemented because projects were selected on subjective judgment and organizations lacked adequate instruments to prioritize projects, which eventually
reduced the profitability of the organization. Moreover, implementation of Six Sigma was highly dependent on the change process incorporated in the organization and context of work processes to achieve the objective of continuous improvement. In this instance, employees’ and management’s readiness to change was required for its implementation, whereas flexible frameworks for evaluation of its effectiveness were required to be developed (Aboelmaged, 2009).

**Six Sigma in Construction Industry**

The construction industry was comprised of complex work processes, in which work tasks were combined or interdependent, production flow was complex, and the work cycle was extensive. Construction projects incorporated numerous work structures in the completion of a single project, which required efficient mechanisms of quality management. These included large quantities of concrete and extensive management procedures that were highly bureaucratic in nature. It led towards delays in the completion of projects and hindered the overall quality (Tchidi et al., 2012).

Prevalence of project delays was considered as a prominent concern in the construction industry. Similarly, the occurrence of design errors, late delivery of construction material, equipment malfunctions, poor utilization of labor, and increased physical demand in construction projects hindered work efficiency. In this instance, synergy in Six Sigma mechanism with breakdown activities in construction projects was required, which resulted in the development of Lean Six Sigma practices. In this manner, the objective of quality enhancement addressed shareholder values by means of achieving a higher extent of customer satisfaction and effective resource utilization including cost and time efficiency (Ozug et al., 2012).
Six Sigma was modified to be implemented in the construction industry, in which DCOV practices replaced traditional DMAIC practices. DCOV practices encompass definition, characterization, optimization and validity in work processes, which was found to be highly effective in the achievement of quality objectives. It was implied that Six Sigma based on DCOV practices was able to improve work processes in construction projects and determined the adequate mix of quality enhancement mechanisms that ensured the effectiveness of the overall construction projects. However, implementation of DCOV practices via Six Sigma was highly dependent on effective collaboration between construction managers, architects, engineers and Six Sigma consultants to ensure its implementation throughout construction stages of the project (Tchidi et al., 2012).

Implementation of traditional practices in Six Sigma failed to address business objectives in the construction industry. It led towards enhancing prospects of Six Sigma in accordance with work processes in the construction industry. Construction projects were highly integrated due to which it became challenging for construction and project managers to ensure that quality enhancement practices were implemented at every stage of the project (Ozug et al., 2012). In this instance, a study conducted by Ozug et al. (2012) provided Six Sigma with a design that was integrated with lean practices. The prevalence of Lean Six Sigma in the construction industry was effective because these practices were focused on quality enhancement and the development of efficient workflow.

Increasing demand of customers towards high quality at competitive costs has increased competition in the construction industry. Realization of the significance of construction industry in economic activity has also increased in the context of
performance in the construction industry, which required a higher extent of efficiency in order to meet an increasing demand for construction. Process improvement was considered as an inherent challenge required to be addressed by the management of the construction organization (Bos et al., 2014).

Lean Six Sigma was considered as an effective approach to address concerns related to process improvement in construction organization. The effectiveness of Six Sigma in the construction industry was highly dependent on the development of an effective monitoring mechanism in order to determine the performance of the organization and Six Sigma practices. Construction companies were focused towards determining the overall performance of organization rather than on emphasising the performance of a specific project. In this manner, it became difficult to determine the effectiveness of Six Sigma in a specific project (Lertwattanapongchai & William, 2014).

The performance measurement of Six Sigma was required to be conducted separately for every project because different construction projects tended to vary. For example, the extent of Six Sigma in the quality enhancement of dam construction was not similar to the construction of a residential building. In this instance, organizations were required to modify elements of Six Sigma in accordance with individual project objectives and evaluate the effectiveness of Six Sigma practices with respect to each project (Bos et al., 2014).

The implementation of Six Sigma has been witnessed at a global level due to increased competition and increased demand. The construction industry was also objectified towards addressing the need of its customers by means of offering high quality infrastructure. The construction industry was found to be highly resistant to
organizational change and was found to be focusing on short-term strategies in order to acquire cost-efficiency. It resulted in poor performance due to which inadequate delays in the project took place. It was observed that quality management techniques were implemented in the construction industry; however, these practices were limited to the operational mechanism of the projects (Leonard, 2010).

Construction industry understood the effectiveness of quality management systems. However, senior management of the organizations remained resistant towards incorporating organizational change followed by the implementation of quality management practices. Focus on research and investments in the development of conventional quality management models incorporating Six Sigma was required in the construction industry. Prevalence of audit and performance analysis was also required to be implemented in the construction industry so that different aspects of Six Sigma and its effects on the extent of quality could be determined (Lertwattanapongchai & William, 2014).

Prevalence of the project scheduling approach, information systems to manage project deadlines, and training and development of engineers with respect to quality management practices has been observed in the construction sector. However, quality standards and project scheduling approaches were found to be limited to construction or operational mechanism in construction firms. Management in construction firms was highly aware of the need for quality management approaches and of the significance of Six Sigma practices. However, management was found to be resistant towards taking proactive measures to implement Six Sigma due to the high cost of implementation (Leonard, 2010).
Six Sigma represented a factual method for recognizing the pervasiveness of deformity in work forms. It helped in teaching an orderly approach that led towards systematic change. Six Sigma gave a systematic approach with the end goal being to guarantee prevalence of process change, in which a blueprint for measurement, analysis, enhance and control was determined. Work processes were equipped with procedure control and evaluation approach to enhance business prospects of the organization. Additionally, it provided efficient methods for measuring, examining, and enhancing the core techniques of work processes so that proposed processes remained consistent and improved the overall quality (Tjahjono et al. 2010).

**Six Sigma in Pakistan**

Prevalence of Six Sigma has been observed in the manufacturing industry in Pakistan; however, its implementation in the construction industry was found to be understudied and ultimately stimulated interest in the current research of this thesis. The manufacturing industry encompassed work processes that were repeated throughout production mechanism, which increased workflow with duration of time. On the contrary, the construction industry incorporated construction projects that varied in functions, whereas some basic activities related to procurement, delivery, and efficient utilization of labor were found to be constant (Khan et al., 2008).

It has been argued that quality management practices that were implemented in the manufacturing industry have not addressed the mechanism of work processes that took place in the construction sector. It has been observed that implementation of quality management practices in the construction industry in Pakistan was at inception stage, due to which it was highly essential that administration in the construction industry took
proactive steps in order to implement holistic quality management practices. The construction industry in Pakistan lacked adequate awareness about the effectiveness of quality management practices, which was also considered a major reason for the undermined status of quality management systems (Khan et al., 2008).

The development of information systems was required in order to ensure effective implementation of Six Sigma. It has been argued that implementation of technological advancements was found to be at a slower pace in Pakistan and hence, implementation and inclination towards adopting Six Sigma remained hindered. It was implied that Six Sigma required effective monitoring and evaluation mechanism at every stage of production or work processes, which could be done with the assistance of information systems. The construction industry was deemed resistant towards the adoption of new technology, which eventually hindered prospects for the implementation of Six Sigma (Memon et al., 2012).

The construction industry of Pakistan incorporated effective risk management techniques to enhance the quality of services. The possibility of risks in construction projects was not analyzed. Hence, adequate strategies were not implemented to reduce the prevalence of issues that hindered productivity. Informal and unstructured work mechanism reduced profitability prospects, whereas lack of advanced information about construction techniques and work efficiency reduced the ability to achieve broader financial and business prospects (Choudhry & Iqbal, 2012).

Reduction of defects in the construction sector by means of reducing risks has been observed in Pakistan. Moreover, implementation of Total Quality Management in the construction industry was also evident. In this instance, management of the
construction companies was observed to be highly associated with the implementation of Total Quality Management practices. It helped in increasing quality assurance by means of incorporating process efficiency. However, it focused on maintaining existing quality standards in work processes and hence, hindered the organization’s capability to incorporate process efficiency and process innovation (Memon et al., 2013).

Quality standards tended to differ in the construction industry in Pakistan because they were developed and deployed by the respective management of the organization. It eventually hindered the effectiveness of a standard quality enhancement procedure due to lack of necessary quality guidelines. It also challenged the effectiveness of a standard Six Sigma mechanism in the construction industry because quality standards varied from organization to organization. Moreover, an internal audit system was also not equivalent among construction organizations and hence, it also hindered the effectiveness of Six Sigma practices in the Pakistani context.

The study conducted by Memon et al. (2013) indicated that the effective implementation of ISO 9001 standards was also found to be hindered in Pakistan, which was also considered a major reason for the prevalence of inefficient quality standards. It was implied that effective implementation of the ISO 9001 standard could result in the development of an organizational structure that would focus towards consistent quality management objectives in the industry. It could also provide assistance in the development of quality management philosophy in the organization and hence, could direct the organization to utilize its full potential towards the achievement of quality objectives (Parast, 2011).
The construction industry in Pakistan focused towards customer satisfaction and profitability, which was also an essential aspect of business. However, quality of the final project or project completion was considered less significant than the extent of profitability. It eventually contradicted with long-term prospects of business because construction organizations remained focused towards increasing profitability by means of developing infrastructure that was preferred by customers (Parast, 2011).

The study conducted by Memon et al. (2013) indicated that construction organizations highly considered the prevalence of defects and delays as a major concern. In this instance, a need for the implementation of quality management practices was also observed. However, implementation of quality management practices remained restricted to the operations department in construction organization, due to which overall efficiency in the work processes was not achieved. Prevalence of traditional practices in the construction industry in Pakistan was observed, which also incorporated resistance towards the implementation Six Sigma in Pakistan.

The construction industry also lacked organizational cultural behavior among the employees, keeping employees inactive in utilizing their full potential towards the achievement of work processes. The employees were found to be less motivated towards accepting change in the organizational work processes and lacked an adequate level of dedication. It eventually hindered their inclination towards enhancing their knowledge, skills, and abilities in order to remain competitive and innovative. Similarly, organizations lacked policy related to directing employees towards engaging in such practices that could ensure the prevalence of the latest knowledge and skills. In this
manner, the construction industry failed to achieve the quality objectives and hindered the implementation of conventional means of quality enhancement (Zu et al., 2008).

The construction industry in Pakistan was observed to be following traditional practices, which was making the industry unable to accomplish construction projects in a specific duration of time. Quality management practices were somewhat limited to specific departments, whereas implementation of Six Sigma was required to be deployed in the overall functions of the organization. It eventually required the deployment of Six Sigma practices at the strategic level of the organization in order to ensure its effectiveness. Moreover, management was found to be less concerned about overachieving process schedule. Hence, effective implementation of Six Sigma remained overlooked (Khan et al., 2008).

The study conducted by Zhang et al. (2012) was aimed at determining critical factors related to the effective implementation of Six Sigma in the Pakistani context. The study indicated that management of the organization played a significant role in order to implement Six Sigma mechanism in the organization. It incorporated effective engagement and commitment of top management because top management could delegate Six Sigma practices in the organization and their inclination towards process efficiency could intrigue employees to practice the Six Sigma mechanism.

The extent of communication and evaluation also related to the implementation of Six Sigma in the Pakistani context. The project was required to be objectified towards the goal of cost efficiency, process efficiency, and increased quality. These goals were required to be delegated and communicated with employees so that they would understand the rationale behind the implementation of Six Sigma and quality
management practices, and utilize their best potential to achieve these objectives. Moreover, the extent of performance incorporated in the service sector fluctuated from organization to organization, due to which it was essential that adequate evaluation process was developed to ensure that projects were evaluated on account of effectiveness incorporated by Six Sigma practices.

Organizations tended to share their success stories in order to make industry competitive and declare their prevalence as a market leader. However, such information was usually kept from competitors in order to ensure that competitors did not adapt and increase the extent of competition in the industry. This notion was found to be prevailing in the construction industry in Pakistan, which eventually reduced prospects for determining effective and successful Six Sigma mechanism in the construction industry. The organizations needed to understand that such practices motivated employees in order to contribute their potential in the effective implementation of Six Sigma practices.

It was implied that the construction sector of Pakistan was focused on the implementation of Total Quality Management in work processes and lacked the effective implementation of Six Sigma. It has been observed that Six Sigma focused on determining defects and possible hindering mechanism in the work processes and incorporated process innovation in order to ensure the prevalence of high quality (Tjahjono et al., 2010). In this instance, considering issues related to defects and inadequate identification of process risks, the implementation of Six Sigma was required in the construction industry of Pakistan.

The quality management issues in the construction industry in Pakistan were prominent and required the implementation of effective practices that could increase the
extent of quality. Moreover, lack of information about effectiveness and implementation of Six Sigma was also observed among management of the construction industry. It eventually reduced prospects for increasing quality and achieving process efficiency in the construction industry. Business firms were focused towards increasing organizational profitability and productivity by means of acquiring business opportunity in the construction industry (Pheng & Hui, 2004; Zhang, 2014).

Government policy towards economic and infrastructure development provided an opportunity for firms in the construction industry to enhance their business operations. It provided positive business prospects for construction firms due to the availability of construction projects and trained labor. The government of Pakistan developed a structural reform program, which helped to attract foreign direct investment. The government’s focus towards human resource development by means of offering skill development opportunities eventually increased the availability of potential workforce in the country. Decreased oil prices and development opportunities increased profit potential in the manufacturing sector and hence, incorporated positive financial prospects for the construction industry (GoP, 2015).

The engineering and quality management techniques in the construction industry were required to be enhanced in order to achieve process efficiency and to enhance quality standards. Management in the construction sector was required to incorporate such work practices that enhanced the extent of quality and could ensure increased productivity. Firms in the construction industry also had profit formula that focused on the achievement of adequate return on investment and ensured profitability. In this instance, effective utilization of resources, reduction of delays in the work processes, and
process innovation was required to reduce hindrance in work processes (Haseeb et al., 2011).

Shah, et al. (2016) presented the framework developed on the basis of Six Sigma principles, which was also accepted by construction professionals in Pakistan. However, further studies further revealed that the construction firms lacked resources to implement framework incorporating Six Sigma principles. In this manner, the gap between the prevalence of Six Sigma framework and the firms' inability to implement this framework has been determined. In this instance, it was essential that current trends in Six Sigma in the construction industry of Pakistan were determined in order to understand successful and hindering practices in the construction industry. It would eventually help in determining the areas which needed improvement with respect to the extent of quality.

The implementation of Six Sigma required financial resources, which was also a great concern in the construction industry in Pakistan. Six Sigma was able to provide future financial prospects, which could be a motivating factor in considering its implementation at the organizational level. However, Zhang et al. (2012) argued that Pakistan lacked Six Sigma black-belt professionals, which led to fear of imposing financial risks for construction companies. In this instance, top management of organizations tended to remain restricted towards implementing Six Sigma practices due to lack of professional capability and financial risk.

The construction industry could significantly contribute to uplifting the Pakistani economy because of efficient development of infrastructure. Also there is an adequate amount of construction projects lending to a potential of great profitability. However, the construction industry in Pakistan was found to be utilizing traditional quality
management practices, thereby reducing prospects for long-term profitability and reduced potential of the construction industry. The implementation of Six Sigma could ensure that employees achieved the work-related objectives in an efficient manner and possessed necessary skills in order to ensure effective implementation. It was necessary for the construction industry to grow financially so that it could contribute to economic development. It indicated that organizations in the construction industry needed to become efficient in their work processes. Prevalence of process efficiency was highly dependent on the competitiveness of employees and efficiency of work processes (Zhang et al., 2012).

**Six Sigma and Training and Development**

Effective implementation of Six Sigma was dependent on effective training and development processes in the organization. This implementation process incorporated organizational change, in which work processes were improved and enhanced. It eventually required employees to be highly competitive and efficient in order to carry out improved work processes in an effective manner. Effective delegation of Six Sigma required top management to understand the effectiveness of Six Sigma and allocate adequate resources to support the implementation mechanism. In this instance, it required prevalence of training and development at an organizational level so that leadership could understand the prospects of quality enhancement in an effective manner (Antony, 2014).

Employees needed to learn adequate skills and abilities to contribute to the implementation of Six Sigma and carry out Six Sigma practices in an effective manner. In this instance, a formal training mechanism was required, which eventually increased operational costs of the organization. However, it was necessary that such financial
aspects should be considered as a long-term investment, and organization should focus towards transforming into a learning organization in order to become highly competitive and efficient (Antony & Karaminas, 2016).

The implementation of Six Sigma required the implementation of information systems that could monitor and evaluate the effectiveness of quality management practices in accordance with different construction projects. It also required technical training of employees in order to determine the effectiveness of Six Sigma by using adequate statistics and analyses. In this manner, the prevalence of training need took place in order to equip employees with skills that were necessary to ensure the consistent effectiveness of Six Sigma throughout work processes (Antony, 2014).

Training programs, mainly comprising of Six Sigma Black Belts, were developed in order to provide managers and project technicians with a practical understanding of implementing Six Sigma. It focused on equipping employees with statistical tools that were considered prominent in the implementation of Six Sigma at the organizational level. Moreover, it also encompassed prevalence of soft skills by means of efficient problem solving, empowerment, effective communication, and feedback in the organization. It also informed managers how to identify how to implement Six Sigma in work processes, so that decisions of implementation could be made (Antony & Karaminas, 2016).

Training and development required in the implementation of Six Sigma were not limited to the managers, engineers, and architects. It required that the organization involved departmental managers and vendors so that a collaborative approach in its implementation could be incorporated in an effective manner. It had a tendency to
provide the organization with a strong competitive edge over its competitors and could result in long-term profitability and efficiency. Managers were required to incorporate innovative solutions in accordance with Six Sigma practices that ensured that innovative solutions were supported by vendors or suppliers to ensure efficient delivery of construction material and machinery (Antony, 2012).

Implementation of Six Sigma was considered as an innovative approach. In this instance, early adopters or highly innovative or conventional organizations were considered to implement Six Sigma design in their work processes. These early adopters of this approach became persuaders or referents in the industry. It helped in the development of quality benchmarks that eventually intrigued other organizations to follow a similar approach and remain competitive in the industry (Antony, 2012).

It also resulted in the transfer of knowledge from one organization to the other, and these organizations tended to observe implementation techniques and adapt these techniques in accordance with their work processes. It eventually helped managers to understand the effectiveness of such practices and intrigued them to implement similar or more competitive practices to achieve quality and performance objectives. The effective implementation of Six Sigma was highly dependent on the successful transfer of knowledge incorporated by replication and adoption of quality management practices (McAdam et al., 2014).

The implementation of Six Sigma highly affected the extent to which managers, work teams, and subordinates carried out their work-related tasks. Its implementation modified work-related aspects of the job and required employees to learn necessary skills that were needed to accomplish such tasks and duties. It eventually increased the need for
training and development in the organization and directed organizational focus towards transforming its human resources into competitive human capital that could ensure cost-efficiency and process improvement in long-term (Antony & Karaminas, 2016).

Six Sigma focused on enhancing the overall quality of work processes in the construction industry, which eventually included all functions and departments in construction organization. It eventually indicated that all functional managers in the organization were required to be informed about the effectiveness of Six Sigma by means of identifying hindrances in work processes. However, the effectiveness of Six Sigma training programs was highly dependent on the identification of learning needs among employees and their extent of readiness to learn new skills. It eventually directed prevalence of effective implementation towards managers who were required to motivate employees towards the acquisition of new skills and competencies in order to practice elements of Six Sigma in work processes (McAdam et al., 2014).

In this instance, employees were required to be motivated intrinsically in order to utilize their potential towards learning practices. Moreover, effective incorporating of continuous learning and development was also required at the strategic level in order to make employees inclined towards learning aspects of their job. Moreover, employees were encouraged to contribute to the achievement of organizational objectives resulting in proactive measures in enhancing their skills and become highly compliant with the Six Sigma practices in the organization (Antony, 2014).

The practice of transformational leadership was also required to incorporate training and development inclinations among employees. It helped managers to assist employees with respect to their learning needs and provided employees with broad
prospects of their job. It also helped in the development of challenging environment that made employees enhance their skills by means of engaging in learning practices.

Moreover, it was also essential that organizations provided effective learning and development opportunities to employees to provide them with adequate career development prospects and intrigued them to become highly competitive by means of understanding and to practice the Six Sigma mechanism (Laureani & Antony, 2015).

Employees developed strong inclinations towards learning activities and training opportunities when they were evaluated on the basis of their performance. It intrigued employees to perform at a higher level, whereas employee performance standards should address skills and abilities that are required to implement Six Sigma practices (Laureani & Antony, 2015). In this manner, it could intrigue employees to engage in learning and development practices in order to incorporate an optimum level of individual performance (Antony, 2012).

It eventually indicated that effective integration of Six Sigma with individual performance of employees and training objectives was essential to ensure effective deployment of Six Sigma in the organization. Therefore, integrating Six Sigma practices with training objectives and performance metrics of employees could direct organizational focus towards implementation of Six Sigma throughout work processes in the organization (Antony, 2012).

Employees tended to play a prominent role in incorporating decisions that could enhance the quality of services. Front-line employees were able to determine hindrances in work processes by observing working mechanism at construction projects. They could also determine the extent of satisfaction among customers with respect to services that
were provided to them. In this instance, effective training related to Six Sigma practices could equip employees to actively engage in identification of hindrances in the overall quality and work processes. Similarly, these employees could determine adequate solutions because they understood stakeholders’ concerns and had adequate knowledge about work processes. These employees were motivated to engage in the effective decision making processes because they understood their contribution to the organization and were objectified to achieve their objectives of performance that dictated prevalence of Six Sigma in work processes.

Six Sigma ensured that managers were provided with adequate information about the progress of construction projects. Information encompassed statistics related to quality standards and customer expectations, and qualitative data was transformed into the standard measurable scale so that its extent could be determined statistically. Quality standards also addressed the scope of employee performance and their contribution to Six Sigma practices and hence, it provided a holistic perspective on its effectiveness. Managers evaluated data and determined adequate implication and identified areas of improvement by means of identifying the need for additional training and process improvements (Antony, 2014).

The increased focus towards customer satisfaction, process improvement, cost and time efficiency, and quality enhancement prevailed at a global level. In this instance, various quality enhancement mechanisms were proposed in order to assist business organizations to achieve organizational objectives. Six Sigma was inclined to increase the efficiency of work processes. Because of this, it was critical that business professionals were informed of its prospects, implementation, and management. In this instance,
international educational institutions had deployed several educational and training programs in order to ensure that professionals understood its implications.

Similarly, these programs were further deployed in the organizations with the integration of organizations with educational institutions. Organizations referred its employees to educational institutions in order to equip them with the latest work dynamics, strategies, and work mechanisms. Therefore, such organizations were known as learning organizations due to their strong inclination towards learning and development activities and strategic integration towards continuous learning. In this instance, PIQC has been objectified to address learning needs of business professionals, and it was necessary that construction industries became responsive towards the needs of organizational learning and considered strategic integration with such educational institutions as could ensure the increased competitiveness of employees (Antony, 2014).

**Six Sigma and Implementation Barriers**

The study conducted by Desale, et al. (2013) was aimed at investigating barriers that construction companies faced in implementation of Six Sigma in developing countries. It was observed that Six Sigma was considered as a most prominent value enhancement strategy in developed countries; however, its effectiveness in developing countries remained undermined. It implied Six Sigma was an effective means of increasing quality, reducing defects, increasing output, and profitability of the organizations. However, due to lack of innovation, resistance towards the implementation of Six Sigma has been observed in developing countries. Moreover, lack of trust between the private sector and government was one of the major reasons that private companies
tended to remain less responsive towards the achievement of national objective. Hence, they disregarded the need of quality enhancement as well.

Technological barriers were also observed in the effective implementation of Six Sigma because the construction industry was highly dependent on construction machinery and planning technologies. Process improvement in order to enhance quality required prevalence of updated technology in order to support tangible and intangible aspects of the construction project. The construction industry tended toward traditional work processes and preferred manual labor over automation, which reduced efficiency, while increasing time and defects (Naslund, 2008).

Financial barriers were also observed in the effective implementation of Six Sigma because the prevalence of automation, process efficiency, and training of employees required financial resources. Implementation of the change process in the organization also required the hiring of change agents in order to incorporate organizational change, which eventually incurred additional cost. Implementation of Six Sigma provided cost efficiency, but it also required capital investment by means of tangible resources, which was considered as a significant challenge for construction companies (McAdam et al., 2014).

Accounting techniques also challenged implementation because Six Sigma reduced the prevalence of defects in the product, which could enhance quality but decrease the overall productivity. The extent of productivity was comprised of high quality resources and efficient utilization of these resources. However, traditional managerial and accounting aspects focused on the extent of productivity without considering the extent of productivity in a broader perspective (Antony, 2012).
Implementation of Six Sigma required organizational inclination towards incorporating overall efficiency and quality in work processes. In this instance, it was necessary that organizational change take place by means of Six Sigma practices. These changes were delegated in the organization from top management. Similarly, overall departments in the organization were required to contribute to effective implementation of Six Sigma, rather than depending on the operations department to incorporate Six Sigma implementation. In this instance, the capital requirement was to be addressed by the finance department. Also the human resource department should provide training and development opportunities to employees (McAdam et al., 2014).

The marketing department should inform the internal and external stakeholders and government of the effectiveness of Six Sigma and the organizational inclination towards it so that the organization could acquire a competitive advantage from the support of related stakeholders. Similarly, the procurement department also needed to manage the inventory in such manner that the aspects of Six Sigma were addressed in an effective manner. The information technology department could also consider the implementation of adequate project management solutions so that the managerial staff could monitor, evaluate and improve the mechanism of Six Sigma practices (Banawi & Bilec, 2014).

Cultural factors could also hinder effective implementation of Six Sigma practices in the work processes of construction firms. The culture encompassed attitude, behavior, and norms of an organization that was embedded in work processes. Employees tended to possess restrictive attitudes towards adoption of conventional practices and could also develop resistance to accepting change in the organization. Moreover, employees might
not perceive conventional quality practices or Six Sigma effective enough to achieve organizational objectives. It was also implied that organizational culture might not be inclined towards innovation, which could hinder the employees’ inclination to accept and implement innovative and conventional solutions to enhance quality (Haseeb et al., 2011).

Leadership, communication systems, and motivation levels in the organization also played a prominent role in effective implementation of Six Sigma. In this instance, lack of transformational and effective leadership could hinder employees’ inclination towards accepting conventional practices of quality enhancement. Inadequate communication systems in the organization could cause ambiguity among employees related to process improvement and quality enhancement practices, which could eventually reduce morale in the organization. Learning organizations tended to have a positive attitude and high motivation among employees towards the adoption of new practices. However, in developing countries, the extent of a positive attitude was low, which eventually hindered implementation of quality enhancement practices in the organization (Antony, 2012).

Six Sigma was initially developed in order to meet quality enhancement objectives in the manufacturing industry. It eventually diverted traditional managers towards considering that Six Sigma could provide effective results in the manufacturing industry, where the manufacturing process was limited to the production of units. In this instance, managers did not consider implications of Six Sigma in the construction industry. Hence, these managers did not take proactive measures in developing a
company focused on the Six Sigma framework in order to meet quality objectives (Ismyrlis & Moschidis, 2013).

Work processes in the construction industry included a planning mechanism at company headquarters, whereas construction took place at different sites. In this instance, it became challenging to integrate work processes that took place at different locations without the prevalence of adequate integrating strategies by means of implementing Six Sigma at the organizational level. Resistance to the implementation of Six Sigma was also observed because employees in the construction industry were unskilled with respect to technological advancements and hence, they considered that implementation of innovative solutions by means of quality enhancement practices might lead towards job insecurity (Antony, 2012).

This reduced inclination towards acceptance and implementation of Six Sigma practices at the organizational level. Moreover, traditional work processes in the construction industry were focused towards developing efficiency in the project by means of incorporating effective project management techniques. In this manner, the prevalence of efficiency was considered to be limited to the role of project managers. Therefore, implementation of Six Sigma at the organizational level remained hindered due to the prevalence of misconception about the role of project managers in the construction industry (Parast, 2011).

Implementation of Six Sigma was challenging in the construction industry because the construction portfolio of construction organizations significantly differed in the industry. In this instance, development of integrated Six Sigma practices was required so that different projects could be incorporated into a quality enhancement mechanism.
Implementation of Six Sigma was a one-time procedure. However, in the construction industry, it was required that Six Sigma should be modified in accordance with different characteristics, objectives, and requirements of different construction projects. It indicated that project managers, engineers, consultant engineers, and architects should be adept at the practical implementation of Six Sigma in work processes in order to ensure consistent implementation of Six Sigma throughout the portfolio of construction companies (Bos et al., 2014).

Inadequate allocation of resources was also observed in the construction organizations, which made implementation of Six Sigma extremely challenging. Resources were comprised of human and financial resources, and construction organizations tended to follow traditional practices, which eventually hindered investment prospects in such organizations. Shortage of development of quality management policies was observed, which eventually reduced the possibility of incorporating proactive means and innovative quality systems in the organization. Moreover, a feedback mechanism also played a prominent role in effective implementation of Six Sigma. It was observed that feedback mechanism remained hindered in construction organizations, effectively keeping management unaware of project and system issues that caused inefficiency (Khan et al., 2008).

It has been argued that in some organizations, feedback was not welcomed from subordinates, whereas in some organizations, feedback was not provided with the relative significance. In this instance, the gap in the identification of unnecessary delays remained unnoticed. The organizational focus in developing adequate policies to ensure implementation of Six Sigma remained hindered and focus towards quality enhancement
refrained from the development of an adequate action plan for the achievement of quality objectives (Parast, 2011).

Moreover, Khan et al. (2008), found that quality management practices were not reviewed and evaluated on a continuous basis, due to which management remained unaware of hindrances in current quality management systems in the organization. It also reduced organizational inclinations towards the development of effective quality management design and hence, organizations remained focused towards utilizing traditional quality management practices. Effective implementation of Six Sigma was based on needed identification of quality enhancement practices by means of determining ineffectiveness of a traditional quality management mechanism.

The construction industry also lacked a precise internal audit mechanism. Therefore, the effectiveness of current quality management practices remained unnoticed. Because of this, the need for enhancing quality management practices remained hindered. Moreover, employees were not empowered to indicate the prevalence of the faults and antecedents of delays in work processes, which was also a major obstacle in the implementation of Six Sigma. The inadequate implementation of ISO 9001 also made organizations highly unstructured to address quality concerns. Effective implementation of ISO 9001 ensured employees’ responsibility, duties, and roles that were necessary for ensuring quality in work processes (Khan et al., 2008).

Organizations were found to be affected by organizational culture and organizations that were highly innovative tended to implement Six Sigma practices in an efficient manner. Similarly, the organizational culture shaped organizational values, which affected the beliefs of employees. In Pakistan, it was observed that employees
lacked the potential to understand their work dynamics and did not identify their strengths and weakness, which hindered their ability to incorporate continuous improvement by means of increasing their context of skills, knowledge, and abilities. It also made employees slow to understand the significance of quality in work processes, which created obstacles in the effective implementation of Six Sigma.

The construction industry tended to compete at the national level in Pakistan. In consideration of similar construction organizations in Pakistan, these organizations lacked concern towards competing in accordance with global standards. Moreover, adequate benchmarking techniques were found to be absent that would have determined the extent of quality in the construction industry in Pakistan and the extent to which quality prevailed in global construction organizations. In this instance, organizations remained unaware of their extent of performance and hence, disregarded inclination towards continuous improvement in work processes (Parast, 2011).

The effective implementation of Six Sigma was also found to be dependent on a recognition and reward system in the organization. A reward and recognition mechanism motivated employees intrinsically and extrinsically to achieve their work-related objectives. Since top management incorporated the implementation of Six Sigma by means of effective delegation, Six Sigma practices could be transformed into performance standards required by the organization (Zhang et al., 2012).

A reward mechanism of the organization was integrated with effective implementation of Six Sigma that could motivate the employees to practice Six Sigma mechanism throughout the work processes. Similarly, academic and professional knowledge of Six Sigma among employees could also be considered for the prevalence
of job promotions and job enrichment, which eventually made employees inclined
towards engaging in acquiring professional and academic knowledge about Six Sigma
and become certified Six Sigma black belt professionals (Zhang et al., 2012).

Implementation of Six Sigma practices was highly dependent on the change
management strategy of the organization. The process of change management was a top-
down approach in which support of management was considered essential to intrigue
employees to implement Six Sigma in their work processes. However, change
management was critical because it could incorporate negative behavior among
employees because they tended to feel over-burdened with change management
processes. Similarly, it required management’s prior knowledge of transformational
leadership so that effective change management mechanisms could be employed in the
organization. The change management process was critical and could incorporate
negative results if it was not implemented throughout the organization and could also
incorporate biases caused by lack of transparency in the objective of change management
process (Banawi & Bilec, 2014).

Implications for Current Study

Six Sigma provided a systematic approach to ensure process improvement and
quality enhancement. The construction industry incorporated complex work processes
that caused project delays and required a higher extent of efficiency to ensure completion
of construction projects in a timely manner. The construction industry in Pakistan faced
similar challenges related to project delays, lack of cost and time efficiency, and
inadequate utilization of resources. Six Sigma was considered as an effective mechanism
to address these concerns. The review of the literature indicated that the construction
industry in Pakistan utilized quality management practices. However, effective implementation of Six Sigma was not observed in the construction industry. Effective implementation of Six Sigma required its integration with organizational culture and top management. Moreover, it required prevalence of practical and academic knowledge about Six Sigma among employees; in particular, lower to middle management. In this manner, it was essential to identify these trends so that the extent of Six Sigma could be determined and effective implementation strategies for Six Sigma could be developed.
Methodology

Research Design

The current study incorporated explanatory research in order to understand the prevalence of current trends in Six Sigma in the construction industry in Pakistan. It focused on determining variables that played a prominent role in the implementation of Six Sigma and understanding current quality enhancement practices that were carried out in the construction industry. Similarly, explanatory research could also help in identifying the procedural enhancements that were required to be implemented in Six Sigma practices in order to make it relevant to the construction industry in Pakistan.

In this instance, a quantitative approach was utilized in order to address research objectives of the current study. Data was collected by means of a structured questionnaire survey that helped in determining inclinations of the respondents towards the prevalence of Six Sigma in the construction industry in Pakistan. The current research accounted for a cross-sectional study, in which primary data was collected from managers in a specific point of time by means of a structured questionnaire.

Participants

The current study targeted the construction industry of Pakistan and therefore participants were employed in the construction companies. The participants were employed at the managerial level in the organization because the effective implementation of Six Sigma accounted for managerial implications rather than being limited to a specific department or project team. The study was conducted at the managerial level because managers were responsible for operations and application of any quality control method. In this instance, data from managers in the construction
industry was acquired to carry out empirical analysis in order to address research questions of the current study.

Of the 210 listed construction companies in Pakistan located in Karachi, Lahore, Islamabad, Faisalabad, Rawalpindi, and Sialkot, the current study accounted for 100 companies located in Karachi, Lahore, and Islamabad. The data was collected using an online questionnaire sent to respective managers via email. The current study accounted for a sample size of 100 participants. According to Zikmund et al. (2013), sample size addressing 43% to 51% of the overall population was considered acceptable. In this instance, the current study was addressing 47.6% companies of the overall population, which eventually justified the sample size of the current study.

Data Collection

The data was collected by means of an online survey, which online questionnaire was sent to participants via email. The process of data collection began after contacting the construction companies via telephone and emails in order to contact respective managers regarding their participation in the study. Managers were briefed about the objective of the current study and the extent to which the findings of the current study could provide adequate managerial implications to increase quality in the construction industry. Afterward, managers were sent an email that was comprised of a disclaimer, research objectives, and questionnaire survey. The disclaimer ensured managers about the privacy of their responses and identity. It also provided formal underpinning about the academic use of the current study. Moreover, IRB approval and WKU’s consent form were also attached with the disclaimer to provide managers with the academic prevalence of the current study. Respective managers filled out the survey questionnaire and sent it
back to the researcher, and this data was prepared for further analysis. This data was collected from 100 construction companies, and a list of those companies was provided in Appendix B.

**Instrumentation**

The survey questionnaire utilized a 7-point Likert scale, ranging from strongly disagree to strongly agree. The demographics of the survey included Age, Education, Gender, and Experience. One on the Likert scale indicated the strongest level of disagreement, whereas a seven indicated the highest level of agreement. Four indicated a neutral or moderate response. The survey incorporated four sections. The first section was comprised of questions which would determine the current trends in Six Sigma. The responses to these questions could answer the research question “What were the current trends in the construction industry in Pakistan?” that was raised in chapter 1. The second section of the survey was comprised of the questions related to the perceived effectiveness of Six Sigma and responses towards this section would answer the research question “How adequately has Six Sigma been implemented in the construction industry in Pakistan?” The third section was related to the prior knowledge of Six Sigma among managers. It would address the research questions RQ3, RQ4, and RQ5. The last section which was concerned with training needs would address the research question RQ6. The survey questionnaire for the current study was shown in Appendix A.

**Data Analysis**

The data was analyzed using the Statistical Package for Social Sciences (SPSS), version 21. The data was screened for missing values and was analyzed by using the variance between the mean score of responses. It illuminated the respondents’ inclination
towards current trends, awareness, industrial implications, and training needed in the construction industry. The current study incorporated descriptive statistics in order to determine the mean statistics and standard deviation in the responses. It helped in determining the extent to which respondents had agreed or disagreed and the extent to which results tended to differ by means of the frequency distribution.

Similarly, it also showed the extent to which responses tended to diverge from mean values and the extent to which they differed from the square of the mean value (Zikmund et al., 2013). A reliability test was conducted in order to determine the validity of the instrument that was used in the current study in order to determine the prevalence of the consistency and reliability of results in the development of practical implications.

**Threats to Validity**

The prevalence of missing values could throw into question the validity of the responses, and hence, an online survey questionnaire ensured that missing values were not present in the data. Reliability testing of data also helped in determining the extent of validity that the instrument afforded towards the formulation of results. The data was analyzed after deriving mean statistics for each item in order to ensure consistent results.
Findings or Results

This chapter encompasses results that were acquired from empirical analysis of data. In the first part of this chapter, the descriptive profile of the respondents is presented. The second part encompasses the descriptive statistics of the responses. The third part of the chapter addresses the reliability testing, and the research objectives are addressed in the fourth part of this chapter. The current chapter concludes with the summarization of the results.

Respondents’ Profile

The current study included a sample size of 100 managers, out of which there were no missing values in the responses. In this manner, missing values were restricted from data, and the descriptive statistics for demographic information was conducted. The descriptive profile of participants was illustrated in Table 1 that addresses the respondents’ age, education level, gender, and work experience.

Their descriptive profile indicated that 25% managers were aged between 31 to 35 years and this stratum was found to be the largest percentage of managers in the sample size of 100 participants. Twenty-one percent of the managers were aged between 35 to 40 years, 20% were in the age bracket of 41 to 45 years, and 14% were 26 to 30 years old. However, 10% of the managers accounted for the age bracket of 20 to 25 years and 46 to 50 years.

Respondents with a bachelors’ degree accounted for 38% of the sample size, whereas a master’s level of education was had among 39% of the overall sample. There were only 2% of the participants with the M.Phil. Degree, whereas 11% of the
participants indicated other academic qualifications, mainly comprising of Post Graduate Diplomas and Post Graduate Certifications.

The overall data was comprised of 10% female and 90% male respondents. It was observed that respondents who had the work experience of fewer than three years accounted for 10% of the overall sample, whereas 25% of the respondents were found to have had work experience between five to ten years. Similarly, 20% of the respondents had between ten to fifteen years experience. Thirty percent of respondents had experience levels between fifteen to twenty years. Fifteen percent of participants claimed to have had work experience of more than two decades. This indicated that the construction industry employed highly educated and experienced professionals.

Table 1.

Respondent’s profile.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Category</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>20-25 years</td>
<td>10</td>
<td>10.0</td>
</tr>
<tr>
<td></td>
<td>26-30 years</td>
<td>14</td>
<td>14.0</td>
</tr>
<tr>
<td></td>
<td>31-35 years</td>
<td>25</td>
<td>25.0</td>
</tr>
<tr>
<td></td>
<td>36-40 years</td>
<td>21</td>
<td>21.0</td>
</tr>
<tr>
<td></td>
<td>41-45 years</td>
<td>20</td>
<td>20.0</td>
</tr>
<tr>
<td></td>
<td>46-50 years</td>
<td>10</td>
<td>10.0</td>
</tr>
<tr>
<td>Education</td>
<td>Bachelors</td>
<td>38</td>
<td>38.0</td>
</tr>
<tr>
<td></td>
<td>Masters</td>
<td>49</td>
<td>49.0</td>
</tr>
<tr>
<td></td>
<td>M.Phil.</td>
<td>2</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>11</td>
<td>11.0</td>
</tr>
<tr>
<td>Gender</td>
<td>Male</td>
<td>90</td>
<td>90.0</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>10</td>
<td>10.0</td>
</tr>
</tbody>
</table>
Experience

<table>
<thead>
<tr>
<th>Experience</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 3 years</td>
<td>10</td>
<td>10.0</td>
</tr>
<tr>
<td>Between 5 to 10 years</td>
<td>25</td>
<td>25.0</td>
</tr>
<tr>
<td>Between 10 to 15 years</td>
<td>20</td>
<td>20.0</td>
</tr>
<tr>
<td>Between 15 to 20 years</td>
<td>30</td>
<td>30.0</td>
</tr>
<tr>
<td>Above 20 years</td>
<td>15</td>
<td>15.0</td>
</tr>
</tbody>
</table>

**Analysis of Descriptive Statistics**

The current study incorporated variables that were measured on a 7-point Likert Scale, with values between 1-7. In this study, a mean value of four was considered moderate. The standard deviation helped to determine the extent of agreeability among respondents. A small standard deviation indicated a higher level of agreeability in responses of respondents, whereas a high standard deviation indicated a low degree of agreeability. The results of descriptive statistics were illustrated in Table 2.

In this instance, it was observed that Current Trends in Six Sigma (CTSS) indicated moderate value with a 3.5067 mean value, whereas standard deviation was 0.38175 showing a high level of agreeability in responses. Similarly, Perceived Effectiveness of Six Sigma (PESS) was found to have a standard deviation of 0.29442, which indicated the highest level of agreement among respondents. However, its mean value was found to be 5.7825, which indicated a low level of moderation.

The mean value for Perceived Knowledge of Six Sigma (PKSS) was found to be 4.7920, depicting moderation, whereas standard value accounted for 0.43291, which indicated the extent of agreement among respondents. Moreover, Training Need for Six Sigma (TNSS) was found to have the mean value of 6.3383, which indicated that respondents had highly agreed with items in this variable. However, it had a standard deviation of 0.75339, which indicated a low level of agreement among the respondents.
Table 2.

*Descriptive statistics*

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Trends in Six Sigma (CTSS)</td>
<td>3.5067</td>
<td>0.38175</td>
</tr>
<tr>
<td>Perceived Effectiveness of Six Sigma (PESS)</td>
<td>5.7825</td>
<td>0.29442</td>
</tr>
<tr>
<td>Perceived Knowledge of Six Sigma (PKSS)</td>
<td>4.7920</td>
<td>0.43291</td>
</tr>
<tr>
<td>Training Need for Six Sigma (TNSS)</td>
<td>6.3383</td>
<td>0.75339</td>
</tr>
</tbody>
</table>

**Reliability Testing**

Reliability testing was aimed at determining acceptance of the instrument that was used in the current study for measuring the current variables in order to support the research objectives. In this instance, the value of Cronbach’s Alpha for each variable was interpreted in order to determine the extent of reliability. It was implied that Cronbach’s Alpha indicating the value of more than 0.6 was considered acceptable to measure variables in an effective manner (Sekaran, 2006). The results of reliability testing were illustrated in Table 3.

Table 3

*Reliability testing of variables*

<table>
<thead>
<tr>
<th>Variables</th>
<th>Cronbach’s Alpha</th>
<th>No. of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Trends in Six Sigma (CTSS)</td>
<td>0.823</td>
<td>9</td>
</tr>
<tr>
<td>Perceived Effectiveness of Six Sigma (PESS)</td>
<td>0.635</td>
<td>4</td>
</tr>
<tr>
<td>Perceived Knowledge of Six Sigma (PKSS)</td>
<td>0.678</td>
<td>5</td>
</tr>
<tr>
<td>Training Need for Six Sigma (TNSS)</td>
<td>0.683</td>
<td>5</td>
</tr>
</tbody>
</table>
The reliability test for variable Current Trends in Six Sigma (CTSS) indicated a Cronbach’s Alpha value of 0.823 and encompassed nine items in the instrument. The variable of Perceived Effectiveness of Six Sigma (PESS) accounted for the alpha value of 0.635 and comprised four items. Similarly, the variable of Perceived Knowledge of Six Sigma (PKSS) indicated the alpha value of 0.678, whereas Training Need for Six Sigma (TNSS) indicated the alpha value of 0.683, and both variables incorporated five items. In this manner, the alpha value for all the variables was found to be greater than 0.6, which indicated that this instrument was acceptable in measuring the determined variables.

**Analysis of Research Objectives**

Research objectives of the current study were aimed at determining the current trends, the extent of implementation, prior knowledge, awareness, and training need for Six Sigma in the construction industry in Pakistan. In this instance, the magnitude of response for each item was determined and illustrated in a graphical manner in order to provide extensive insights about responses and addressed research objectives. The first item of the questionnaire addressed the extent of the contribution of the organization’s leadership in defining, measuring, analyzing and improving the business operations, and the results were illustrated in Figure 1.
Figure 1. Bar graph showing results from the statement that “Organizational leadership defines, measures, analyzes and improves the business operations.”

The results indicated that 60% of the total respondents strongly disagreed that the organizational leadership engaged in defining, measuring, analyzing and improving the business operations, whereas 10% of the respondents mostly disagreed with this notion and 30% of the respondents somewhat disagreed. The overall results indicated that the construction industry in Pakistan lacked active participation in the organization’s leadership to improve business operations.
It was observed that 49% of the participants somewhat agreed with the notion that the organization was focused towards quality enhancement, whereas 41% of the participants mostly agreed with this notion. However, 10% of the respondents indicated a neutral response indicating the prevalence of other inclinations in the organization with respect to process efficiency in the construction industry in Pakistan. The results were illustrated in Figure 2.

Figure 2. Bar graph showing results addressing the statement “The organization is highly focused towards enhancing quality by means of process efficiency.”
The results indicate that 39% of the respondents strongly disagreed with the prevalence of organizational vision towards quality enhancement, whereas 30% of the respondents mostly disagreed with this notion. Similarly, 31% of the respondents somewhat disagreed. However, the overall respondents indicated that the organizational vision did not address quality enhancement, which eventually indicated that quality enhancement, by means of Six Sigma, was not embedded in the construction industry in Pakistan. The results were illustrated in Figure 3.
Figure 4. Bar graph showing results about the statement: “The organization is highly focused towards waste reduction and reducing unnecessary delays in construction projects.”

The results indicated that 10% of the respondents somewhat agreed with the notion that waste reduction practices and strategies to reduce delays in construction projects were practiced in the organization. However, 79% of the respondents mostly agreed, and 11% of the respondents strongly agreed with the implementation of such strategies in the organization. The graphical representation of these results was illustrated in Figure 4.
Figure 5. Bar graph showing results addressing the statement: “The organization is responsive towards increasing focus on infrastructure in order to meet the customer / national demand.”

The results indicated that 39% of the participants strongly disagreed with the idea that their organization was responsive towards the customer and national demand for building infrastructure. The results also showed that 41% of the managers mostly disagreed, whereas 20% of the managers somewhat disagreed with the idea. In this instance, it was observed that construction in Pakistan was not focused towards addressing business opportunities developed by national demand for construction projects in the country. The results were illustrated in Figure 5.
Figure 6. Bar graph showing results addressing the statement: “The work processes in the organization take place within an optimum duration.”

The results illustrated in Figure 6 indicated that 11% of the respondents strongly disagreed with the idea that the organization could accomplish its projects within an optimum duration, whereas 48% of the respondents strongly agreed with this idea. Similarly, 20% of the respondents mostly disagreed, whereas 21% of the respondents mostly agreed with this notion. It indicated that process efficiency in the construction industry in Pakistan varies from company to company.
Figure 7. Bar graph showing results addressing statement: “Project management teams work together in a collaborative manner.”

The results illustrated in Figure 7 indicated that 10% of the respondents somewhat agreed that project management teams worked in a collaborative manner. However, 41% of the respondents mostly agreed, and 49% of the respondents strongly agreed with this notion. It effectively depicted prevalence of teamwork in the construction industry in Pakistan and indicated the participation of team members in achieving the organizational objectives.
Figure 8. Bar graph showing results addressing the statement: “The organization can accomplish construction projects before initial deadline.”

The results illustrated in Figure 8 indicated that 11% of the respondents strongly disagreed with organization’s ability to complete construction projects before the completion of initial deadline. Similarly, 69% of the respondents mostly disagreed with this notion and indicated some extent of delay in the completion of the construction project. However, 20% of the respondents strongly agreed with the idea that their organization had the capability to complete the construction projects within the time limit of the initial deadline. It indicated the prevalence of an inadequate level of consistency in quality in the construction industry in Pakistan.
Figure 9. Bar graph showing results addressing the statement: “Subordinates are highly involved in the problem identification and decision making mechanism.”

The results illustrated in Figure 9 indicated that 50% of the respondents strongly disagreed with the active participation of subordinates in problem identification and decision making in the organization. However, 40% of the respondents mostly disagreed, whereas 10% of the respondents somewhat agreed with this notion. It eventually indicated that empowerment of subordinates and participation of subordinates varied on the basis of organizational inclinations due to lack of a standard quality mechanism in the construction industry.
Figure 10. Bar graph showing results addressing the statement: “Six Sigma can increase quality, cost efficiency and time efficiency in the construction industry.”

The results illustrated in Figure 10 indicated that 69% of the managers somewhat agreed with the effectiveness of Six Sigma in increasing quality, cost, and time efficiency in the construction industry. However, 21% of the respondents mostly agreed with his notion, whereas 10% of the respondents indicated a neutral response. It eventually indicated that a large number of managers understood the effectiveness of Six Sigma. However, some managers were unsure about the effectiveness of its implementation in the construction industry.
Figure 11. Bar graph showing results addressing the statement: “Current quality management practices are providing a satisfactory level of quality in the construction industry.”

The results illustrated in Figure 11 indicated that 41% of the respondents somewhat agreed with the effectiveness of current quality management practices in the construction industry, whereas 24% of the respondents mostly agreed with this notion. However, 35% of the respondents somewhat agreed, which indicated the prevalence of inefficient practices in the construction industry.
The construction industry requires the effective implementation of Six Sigma

![Bar graph showing results addressing the statement: “The construction industry requires the effective implementation of Six Sigma.”](image)

The results illustrated in Figure 12 indicated that 20% of the respondents somewhat disagreed with the implementation of Six Sigma in the construction industry. However, 51% of the respondents somewhat agreed, and 29% of the managers strongly agreed with the need for implementation. It eventually indicated the prevalence of resistance and lack of information about the effectiveness of Six Sigma among 20% of the respondents of the total sample size.
Figure 13. Bar graph showing results addressing the statement: “Six Sigma will require large capital investments in the construction industry.”

The results depicted in Figure 13 indicated that 1% of the respondents somewhat agreed with the capital investments related to the implementation of Six Sigma in the construction industry, whereas 10% of the respondents strongly agreed with this notion. Moreover, this notion was also supported by 89% of the respondents, which eventually indicated the managerial focus towards short-term cost efficiency that resulted in disregard of the implementation of long-term cost efficient practices.
Figure 14. Bar graph showing results addressing the statement: “I understand the theoretical underpinnings of Six Sigma.”

The results illustrated in Figure 14 indicated that 20% of the managers were familiar with Six Sigma, whereas 80% of the managers had the theoretical knowledge of Six Sigma. It eventually indicated the prevalence of prior knowledge about Six Sigma among managers to a greater extent in the construction industry of Pakistan.
Figure 15. Bar graph showing results addressing the statement: “I have studied Six Sigma during an academic career.”

The results illustrated in Figure 15 indicated that 31% of the respondents had an academic knowledge of Six Sigma with the agreeability level of 31%. Similarly, 69% of the respondents strongly agreed with having an academic knowledge of Six Sigma. It eventually indicated an overall higher extent of academic knowledge of Six Sigma among managers in the construction industry in Pakistan.
Figure 16. Bar graph showing results addressing the statement: “I have practiced Six Sigma in the construction projects.”

The results illustrated in Figure 16 indicated that 44% of the respondents mostly disagreed with the implementation of Six Sigma in the construction projects. Similarly, 56% of the respondents strongly disagreed, which indicated that they had not practiced Six Sigma in the construction projects.
Figure 17. Bar graph showing results addressing the statement: “I have technical certifications in the implementation of Six Sigma.”

The results illustrated in Figure 17 indicated that 69% of the respondents did not have any technical certifications related to the implementation of Six Sigma in the organization. Similarly, 11% of the respondents mostly disagreed with the prevalence of technical certifications. However, only 20% of the respondents indicated that they had technical certification in Six Sigma implementation.
Figure 18. Bar graph showing results addressing the statement: “Six Sigma is an effective means to reduce project delays and increase quality.”

The results illustrated in Figure 18 indicated that 10% of the respondents somewhat agreed with the effectiveness of Six Sigma in reducing project delays and quality enhancement in the construction industry. Similarly, the extent of agreeability was found to be strengthened with 20% of the respondents indicating mostly agreed, whereas 70% of the respondents indicating strongly agreed with this notion.
Figure 19. Bar graph showing results addressing the statement: “The employees do not understand the Six Sigma practices.”

The results illustrated in Figure 19 indicated that 60% of the respondents indicated that employees in their organizations did not understand Six Sigma practices. Similarly, the extent of agreeability was observed with 19% of the respondents mostly agreed and 21% of the respondents indicated somewhat agreed with this notion.
Figure 20. Bar graph showing results addressing the statement: “Organizational awareness is required to carry out Six Sigma Practices.”

The results in Figure 20 indicated that 39% of the respondents strongly agreed that the organizational awareness was required to implement Six Sigma practices. Similarly, 21% of the respondents mostly agree, 20% of the respondents somewhat agreed, and 20% of the respondents indicated a neutral response towards this notion. It eventually indicated that the effective implementation of Six Sigma would require an organizational change in order to support the implementation and practice of Six Sigma.
Figure 21. Bar graph showing results addressing the statement: “The employees lack basic skills, knowledge, and abilities to implement Six Sigma Practices.”

The results from Figure 21 indicated that 70% of the managers strongly agreed that the employees in the organization did not have adequate skills, knowledge, and abilities to implement Six Sigma in the work processes. Similarly, 9% of the respondents mostly agreed and 21% of the respondents somewhat agreed with this notion.
Figure 22. Bar graph showing results addressing the statement: “The employees require formal training and development to understand Six Sigma practices.”

It was observed that 59% of the managers indicated that Six Sigma practices and implementation require the prevalence of formal training and development of employees. Similarly, 21% of the managers mostly agreed with this notion and 20% of the managers somewhat agreed. The results were illustrated in Figure 22.
The employees need to learn knowledge, skills, and abilities for the effective deployment of Six Sigma

Figure 23. Bar graph showing results addressing the statement: “The employees need to learn knowledge, skills, and abilities for the effective deployment of Six Sigma.”

The results illustrated in Figure 23 indicated that 70% of the managers indicated that employees were required to learn the effective deployment mechanism of Six Sigma in order to ensure its effective implementation in the work process. In this instance, 10% of the managers strongly agreed, whereas 20% of the respondents somewhat agreed with this notion.
The competency of employees with respect to Six Sigma practices can be increased with training

![Bar Graph](image)

**Figure 24.** Bar graph showing results addressing the statement: “The competency of employees with respect to Six Sigma practices can be increased with training.”

The results illustrated in Figure 24 indicated that 65% of the managers indicated that training of Six Sigma practices could increase employees’ competency to implement Six Sigma in work processes. Moreover, 15% of the managers mostly agreed, whereas 20% of the managers somewhat agreed with this notion.

**Discussion**

The overall results indicated that managers in the construction industry of Pakistan were highly educated and had significant years of experience in their field of study. The results from the descriptive statistics indicated that the overall responses were
moderate and indicated a high rate of agreeability. The results of the reliability test suggested that the instrument used in the current study provided consistent results over a large population and hence, made results of the current study valid.

The current study was aimed at determining the extent of current trends in Six Sigma, prior knowledge among the managers about the significance of Six Sigma, awareness of its effectiveness and the training need of employees for the effective implementation. In this instance, data was analyzed, and the mean scores of the responses were determined. Afterward, the mean scores were transformed into percentage distribution by using the descriptive statistics for each item, and the results were illustrated using the graphical charts.

The results indicated that leadership or top management in the construction industry in Pakistan did not participate in improving business operations. In this instance, leadership did not engage in defining, measuring and analyzing the business performance because they lacked a vision of continuous improvement in the construction industry. However, results also indicated that Pakistan construction firms were highly inclined towards increasing the extent of quality in the construction projects. Similarly, organizations were inclined towards making their work processes efficient with the use of quality management practices.

The results indicated that construction organizations did not incorporate prevalence of quality enhancement in their organizational vision. It eventually indicated that a quality enhancement mechanism was not embedded in the organizational structure, inclination, culture, and policies because vision determined the inclination of the organization and delegated its elements throughout the organization. However, results
indicated that construction organizations were pointed towards the reduction of waste and project delays in order to ensure efficient utilization of resources and achieve cost-efficiency in the overall construction projects. It eventually indicated that strategies to reduce waste and reduce project delays were implemented to some extent in the construction organizations.

The results indicated that construction organizations were not focused towards addressing increasing national demand for infrastructure in the country. It also depicted that organizations were not focused towards long-term business prospects and were not responsive towards increasing customer and national demand. Moreover, some managers in the construction organizations indicated that construction projects were completed in an optimum duration, whereas some managers indicated that construction projects were not completed within an optimum duration. In this instance, it was implied that the extent of efficiency significantly varied from organization to organization in the construction industry of Pakistan.

Prevalence of collaboration among project team members was closely observed, which eventually indicated that team members worked in a favorable environment to delegate, share, and enhance their skills in an effective manner. It also depicted prevalence of conventional team management practices in the organization. However, it was observed that the construction organizations were not exceeding their level of performance by means of completing the construction projects before the initial deadline. Moreover, inconsistent responses were observed in this notion, which indicated that the extent of process efficiency varies from organization to organization.
It was observed that subordinates were not involved in the problem solving and decision making mechanism in the construction projects and its extent of prevalence was observed to be higher than the participation of subordinates in the organizational decisions and problem solving. It also indicated the difference in quality management systems and work standards in the construction companies in Pakistan. Moreover, managers indicated that Six Sigma could be effective in achieving cost and time-efficiency and could result in a higher level of quality.

However, managers also indicated a high level of agreeability towards satisfaction with current traditional quality management practices. It was indicated that the managers in Pakistan were not inclined towards taking proactive means of enhancing quality standards significantly more than the required extent of quality in the industry. It was also observed that managers indicated the mixed prevalence of agreeability and disagreement in determining the need for implementing Six Sigma. Also, they were not sure about the extent of quality that was required to be achieved by the organization.

Construction managers significantly believed that implementation of Six Sigma required a large amount of capital investment. It eventually indicated that managers were focused towards implementing such quality management practices that could ensure short-term profitability and hence they were disregarding quality management practices that could provide long-term profitability. It was also observed that a significant extent of managers possessed theoretical knowledge of Six Sigma practices and they had studied elements of Six Sigma in their academic career.

However, results also indicated that despite theoretical and academic knowledge of Six Sigma, managers had not practiced the elements of Six Sigma in the construction
projects. It effectively indicated the gap between knowledge and practice of Six Sigma in the construction industry in Pakistan. Managers also lacked adequate professional or technical certifications in Six Sigma practices. This contributed to Six Sigma not being implemented in the construction industry. However, managers indicated that Six Sigma could reduce project delays and enhance quality, which was found to be the antecedent of their academic and theoretical knowledge about elements and effectiveness of Six Sigma. It was also observed that managers indicated a dearth of knowledge about Six Sigma in organizations and indicated that effective implementation of Six Sigma would require an organizational change in order to enlighten management and employees with the effectiveness of Six Sigma. Managers also indicated that employees in organizations did not possess skills, knowledge, and abilities to implement Six Sigma practices. It was observed that training need for Six Sigma practices among employees was significantly high in order to implement Six Sigma in organizations. Managers also indicated that formal training was highly effective in increasing competency of employees, which would result in effective implementation of Six Sigma in organizations.
Conclusion

The overall results of the study indicated that the construction organizations were not inclined towards quality enhancement and process improvement at the strategic level, due to the fact that quality management practices were not embedded in the culture and policies of organizations. Management was resistant towards implementing modern quality management practices because management believed that current practices were providing satisfactory results. However, the occurrence of inadequate project delays was observed throughout organizations included in the survey. In this instance, it was observed that organizations were not inclined towards acquiring increasing business opportunities in the construction industry due to increased demand for infrastructure in the country. Therefore, organizations were not incorporating proactive means of enhancing quality and process efficiency in the construction projects.

Managers understood aspects of Six Sigma. However, they lacked technical knowledge about the implementation of Six Sigma in the organization. Managers indicated that employees lacked adequate skills to contribute to the implementation of Six Sigma because it was required that employees be trained at the organizational level. Managers were found to be concerned about the cost related to the effectiveness of Six Sigma. Hence, they lacked long-term prospects of cost-efficiency acquired by effective implementation of Six Sigma practices.

Key Conclusion

RQ1: What were the current trends in Six Sigma in the construction industry in Pakistan?

Results:
• Organizations showed no inclination towards quality enhancement and process improvement.
• The quality enhancement was absent in organizational vision. Hence, it was not embedded in corporate culture.
• Construction organizations were not focused towards addressing national demand, which indicated the absence of long-term planning.
• Process efficiency varied from company to company.
• Team work and collaboration among team members were observed, but the lack of employee involvement in decision making and problem solving was observed at the same time.

RQ2: How adequately has Six Sigma been implemented in the construction industry in Pakistan?

Result:
• Management showed satisfaction towards existing quality management practices, which indicated they were not inclined towards taking proactive actions to enhance quality.
• There was mixed response in terms of the need for implementation of Six Sigma.
• Managers strongly believed that implementation of Six Sigma would require significant capital investments, which indicated that they were focused towards short-term profitability.

RQ3: What was the extent of adequate knowledge of Six Sigma in the construction companies in Pakistan?
Result:

- Managers had adequate knowledge of Six Sigma; both theoretical and academic, but they did not apply Six Sigma to practice.
- There was a gap between Six Sigma knowledge and its practice.
- A significant number of managers did not possess technical certification in Six Sigma.

RQ4: To what extent did construction companies want to implement Six Sigma?

Result:

- Construction organizations were focused towards quality enhancement but they were focused on short-term cost efficiency, instead of long-term planning.
- Construction organizations were focused towards waste reduction, reduction of delays, and ensuring cost-efficiency.

RQ5: Were construction companies aware of the effectiveness of Six Sigma in Pakistan?

Result:

- Managers indicated that Six Sigma could reduce cost and enhance quality.
- Six Sigma could reduce project delays.
- The results indicated the prevalence of resistance and lack of information towards the implementation of Six Sigma.

RQ6: Was Six Sigma knowledge and training required in Pakistan for its practical application in the construction industry?

Results:
Managers indicated that employees lacked basic skills, knowledge, and abilities to implement Six Sigma.

Managers also indicated that employees need training and development to understand Six Sigma and for its effective implementation.

**Recommendations for Construction Industry**

The infrastructure development in Pakistan was objectified at a national level, and the government’s inclination towards increasing infrastructure development was also observed. Moreover, construction organizations were not found to be inclined towards being responsive towards the increasing national demand, and hence they were focused on short-term growth prospects and were incorporating short-term cost-efficient practices. In this instance, it was highly recommended that the government delegates develop quality enhancement policies and standards in order to direct inclination of construction industry towards the implementation of effective quality management practices. Moreover, the government could create a law through which it would require the construction companies to report in a specific manner by which it would make it compulsory for them to follow quality standards.

The government was found to be focused towards the human development initiatives in which technical training in the field of construction was also provided to citizens. In this instance, it was recommended that the context of training should be extended in such a manner that it addressed the effective implementation of Six Sigma in practice. The development of a national policy towards quality enhancement and availability of human development initiatives focused on Six Sigma would direct the construction organizations to implement Six Sigma practices in the work processes.
It was recommended that managers would assume leadership roles so that they could pave the ground for organizational change. Assuming leadership roles would also enable managers to enlighten employees concerning the effectiveness of Six Sigma practices. Employees would show resistance to change in the quality management system, but strong leadership would be able to persuade them and bring about positive change. At the same, such managers as effective leaders could infuse positive attitudes and motivation in employees.

It was recommended that managers would assume leadership roles in order to facilitate organizational change. Managers through leadership roles could persuade employees, who would be resistant towards a new quality management system. Leadership roles would enable managers to instruct employees on the effectiveness of Six Sigma practices in the organization and would help them understand its contribution in the effectiveness achievement of organizational and national objectives. Moreover, leadership roles would enable managers to infuse positive attitude and motivation among employees.

It was observed that the construction projects vary on the basis of their objectives and structure, and a specific design of Six Sigma mechanism could not have ensured efficient results. It was suggested that company managers, engineers, consultant engineers, and architects should engage in the development of a structured Six Sigma design that could address the project requirements in an effective manner.

Construction organizations were found to be highly focused towards short-term prospects of cost-efficiency. Effective analysis of current quality management practices and effectiveness of proposed Six Sigma practices were required to be measured in order
to determine the financial feasibility of Six Sigma practices in the construction industry. It would have informed stakeholders of the construction organizations about the effectiveness of Six Sigma and long-term prospects of cost-efficiency and profitability could be determined. The organizations needed to be responsive towards increasing national demand for construction. Moreover, positive financial prospects with respect to the implementation of Six Sigma would increase the inclination of construction organizations towards focusing on the long-term prospects of business.

The construction industry was required to provide adequate training and development opportunities to employees in order to develop adequate skills, knowledge, and abilities with respect to the implementation of Six Sigma. The organizations tended to perceive training as a cost of human development practice; however, it should be considered as a long-term investment because it would transform human resources of the organization into human capital. The competitive employees were found to be highly efficient and able to provide the organization with a competitive edge due to innovative solutions and efficient workflow. Prevalence of effective training and development programs related to the practical implementation of Six Sigma could enhance quality and incorporate process improvement in the construction industry of Pakistan.

**Recommendations for Future Studies**

The results of the current study provided extensive insights about the current usage of Six Sigma, knowledge about the implementation of Six Sigma and the gap in the implementation and knowledge of Six Sigma. However, the current study did not provide a systematic design of Six Sigma that could be implemented in the construction industry. Therefore, future studies should focus on the formulation of Six Sigma design so that it
could be implemented in the construction industry. Moreover, empirical evidence about long-term profitability of Six Sigma implementation in the construction industry would be required to induce the construction industry to implement it as a program. It is also essential that empirical relation and causal relation between the given variables should be determined in order to broaden the perspective of the objectives of the current research.

The current study did not determine implications on trends of Six Sigma based on demographics. Future studies could focus on various demographic variables. Future studies could determine how the responses will vary based on different levels of work experience. Similarly, further studies could also determine implications based on education level, age, and gender as well. Such studies could determine how results would differ as work experience and age increases. Moreover, future studies could also determine the perspective of top management by conducting similar research. Such studies would provide a more holistic viewpoint.
Appendix A: Survey Questionnaire

<table>
<thead>
<tr>
<th>Age</th>
<th>Education</th>
<th>Gender</th>
<th>Experience</th>
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</thead>
<tbody>
<tr>
<td>20-25 years</td>
<td>Bachelors</td>
<td>Male</td>
<td>Less than 3 years</td>
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<tr>
<td>26-30 years</td>
<td>Masters</td>
<td>Female</td>
<td>Between 5 to 10 years</td>
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<tr>
<td>31-35 years</td>
<td>PhD</td>
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<td>Between 10 to 15 years</td>
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<tr>
<td>36-40 years</td>
<td>Other</td>
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<td>Between 15 to 20 years</td>
</tr>
<tr>
<td>41-45 years</td>
<td></td>
<td></td>
<td>Above 20 years</td>
</tr>
<tr>
<td>46-50 years</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Over 50 years</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

1 = Strongly Disagree  
2 = Mostly Disagree    
3 = Somewhat Disagree  
4 = Neutral            
5 = Somewhat Agree     
6 = Mostly Agree       
7 = Strongly Agree

1 2 3 4 5 6 7

Current Trends in Six Sigma

Organizational leadership defines, measures, analyzes and improves business operations

Organization is highly focused towards enhancing quality by means of process efficiency

Organizational vision is focused towards quality enhancement
Organization is highly focused towards waste reduction and reducing unnecessary delays in construction projects.

Organization is responsive towards the increasing focus on infrastructure development to meet the customer / national demand.

Work processes in organization accomplish within an optimum duration.

Project management teams (leaders and supervisors) work together in a collaborative manner.

Organization is able to accomplish construction projects before initial deadline.

Subordinates are highly involved in the problem identification and decision making mechanism.

<table>
<thead>
<tr>
<th>Perceived Effectiveness of Six Sigma in Construction Industry</th>
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</thead>
<tbody>
<tr>
<td>Six Sigma can increase quality, cost efficiency and time efficiency in the construction industry.</td>
</tr>
<tr>
<td>Current quality management practices are providing a satisfactory level of quality in the construction industry.</td>
</tr>
<tr>
<td>The construction industry requires the effective implementation of Six Sigma.</td>
</tr>
<tr>
<td>Six Sigma will require large capital investments in the construction industry.</td>
</tr>
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</table>
### Prior Knowledge of Six Sigma Among Managers (Awareness)

<table>
<thead>
<tr>
<th>Statement</th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>I understand the theoretical underpinnings of Six Sigma</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I possess academic knowledge about Six Sigma</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have practiced Six Sigma in construction projects</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have technical certifications in the implementation of Six Sigma</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Six Sigma is an effective means to reduce project delays and increase quality</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Employees’ Knowledge about Six Sigma

<table>
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<tr>
<th>Statement</th>
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<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Employees do not understand the Six Sigma practices</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organizational awareness is required to carry out Six Sigma Practices</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employees lack basic skills, knowledge, and abilities to implement Six Sigma Practices</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employees require formal training and development to understand Six Sigma practices</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employees need to learn knowledge, skills, and abilities for the effective deployment of Six Sigma</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Competency of employees with respect to Six Sigma practices can be increased with training</td>
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</table>
## Appendix B: List of Construction Companies

<table>
<thead>
<tr>
<th>#</th>
<th>Company Name</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Altas Readymix Concrete</td>
<td>Karachi</td>
</tr>
<tr>
<td>2.</td>
<td>Alwasay-Ul-Badi Pvt. Limited.</td>
<td>Islamabad</td>
</tr>
<tr>
<td>3.</td>
<td>AKS Creatives</td>
<td>Islamabad</td>
</tr>
<tr>
<td>4.</td>
<td>S.M Engineering</td>
<td>Karachi</td>
</tr>
<tr>
<td>5.</td>
<td>Rehman Engineers and Builders</td>
<td>Lahore</td>
</tr>
<tr>
<td>6.</td>
<td>Elegant Interior Construction</td>
<td>Karachi</td>
</tr>
<tr>
<td>7.</td>
<td>Z-Stones</td>
<td>Islamabad</td>
</tr>
<tr>
<td>8.</td>
<td>Catch Interior</td>
<td>Karachi</td>
</tr>
<tr>
<td>9.</td>
<td>De Creators</td>
<td>Karachi</td>
</tr>
<tr>
<td>10.</td>
<td>Green Arch</td>
<td>Lahore</td>
</tr>
<tr>
<td>11.</td>
<td>Avera Interiors and Building Contractors</td>
<td>Islamabad</td>
</tr>
<tr>
<td>12.</td>
<td>Ahsan Interiors</td>
<td>Karachi</td>
</tr>
<tr>
<td>14.</td>
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<tr>
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</tr>
<tr>
<td>16.</td>
<td>Luxury Gaters</td>
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</tr>
<tr>
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<tr>
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</tr>
<tr>
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<td>Al-Baraka Construction &amp; Elevators</td>
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<tr>
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<tr>
<td>---</td>
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<tr>
<td>21.</td>
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<td>Islamabad</td>
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<tr>
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<td>---</td>
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