



Impact of Lean Management Practices on Operational Performance: An Empirical Investigation from Construction Supply Chain of Pakistan

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Abstract: Construction sector is considered as the backbone for any country, whereas, supply chain has become an essential part of all industries. Thus, the construction supply chain emerged as a new, independent and crucial segment. During the last few decades, this industry has affected greatly in Pakistan due to unfavorable conditions like inflation, political unrest and the war against terrorism. However, various strategy and approaches are available in the literature that helps this industry to tackle the problems by creating efficiency and effectiveness. Lean management is considered a decisive element for every organization; by applying lean approaches, organizations can enhance the performance for not only the manufacturing sector but also service sectors. The aim of this study is to explore the potential benefits of lean approaches (Total Quality Management, Using 5's Practices and Quick Change Over) in the construction supply chain of Pakistan. Questionnaire has been distributed to the construction supply chain of Pakistan by systematic probability sampling. The population of this study consists of listed construction companies in the 'Pakistan Engineering Council'. Meanwhile, after the screening, 367 responses have been considered and valid for data analysis. The Pearson correlation result indicates that there is strong correlation between Total Quality Management and Operational Performance with $r = 0.801$. The study performed multiple regressions analysis and found the impact of three predictor variables (Total Quality Management $\beta = 0.625$, Using 5S Practices $\beta = 0.524$ and Quick Change Over $\beta = 0.521$) on the criterion variable (Operational Performance). The results revealed that all three variables positively and significantly enhance with the Operational Performance. This study will help the organizations to better understand how construction managers can reduce their workload; make their operations more efficient and productive.

Keywords: Lean practices, operational performance, construction supply chain

1. Introduction

It is the era of technology, innovation, and rapid changes, without construction it is impossible to compete. Although Pakistan has rich resources but still due to political instability, the war against terrorism and inflation, Pakistan failed to compete with the world in construction technology (PES 2018). The construction sector of Pakistan has rapidly developed with a higher growth rate of 9.05% during the period 2016 - 2017. However, a poor record of completing the projects in the allocated time, cost, and desired results are observed. The construction sector has registered a growth of 9.05% against last year's growth of 14.6% (PES 2018). The boom of construction in different

economic zones such as energy, architecture & planning, industrial and transportation, makes it a defining element for the economic progress of the country Ali *et al.* 2018). Though the industry is progressing, the quantum and rate of progress are yet not up to the mark. The construction industry of Pakistan, like other countries around the world, has a poor record in terms of completing projects in allotted time and cost.

Meanwhile, after an extensive literature review, it has been revealed that there are numerous strategies to deal with this issue but the best one is called lean operations, to remove unnecessary elements and decrease the cost that will ultimately increase the performance (Abdallah *et al.* 2014). It has been proved in the literature that by applying lean approaches in operations, performance can be enhanced (Alsmadi *et al.* 2012; Fradinata *et al.* 2017). Previously lean was only applied to manufacturing but with the passage of time now it has been an essential part of all service sectors including the construction sector (Johnpaul, 2016; Walukwe, 2016). Therefore, this study focused on operational performance and its effects on lean approaches (Total Quality Management, Using 5's Practices and Quick Change Over).

2. Construction Industry of Pakistan

Construction is one of the important sectors in Pakistan. It is the largest employment producing sector within the country as well as a vital factor for economic development (Khwaja *et al.* 2018). The industry is progressing, the quantum and rate of progress are yet not up to the mark. The construction industry of Pakistan, like other countries around the world, has a poor record in terms of completing projects in allotted time and cost (Alhosani and Zabri 2018). Growth in construction allied industries stems primarily from consistently rising public spending. The Public Sector Development Programme (PSDP) increased to Rs. 700 billion in 2016 compared to Rs. 350 billion in 2013 showing a growth of 100%, which helped projects related to infrastructure, power generation and development of railways, construction and allied industries (PES 2016). The rise in overall import payments was mainly driven by higher purchases of fuel and capital equipment. This is understandable, given that Pakistan is transitioning from low growth to a higher growth economy, and is therefore faced with supply-side bottlenecks in energy and infrastructure (Khwaja *et al.* 2018). The Power-generating machinery imports increased by 66.8% for the construction sector and this indicating increasing productivity in this sector (Ali *et al.* 2018; Manners-bell 2014; Karia and Soliman, 2017). Construction as a sub-sector contributes 13.13% in the gross domestic product (GDP) last year (PES 2015; Ng and Ghobakhloo 2017). This growth evidenced that the construction sector actively involved in the development of Pakistan.

2.1 Supply Chain Management

According to Wei and Xiang (2013), supply chain management is “a systematic, integrated management philosophy, its core meaning is to enable companies to fully understand the customer and market demand, to keep pace, resource sharing and integration, coordinated support all enterprise collaborative supply chain operations and improve the overall competitiveness of the supply chain, enhance the sensitivity to market risk and effectively meet customer needs of functional systems, build quality brand resources, and ultimately achieve long-term sustainable development of enterprises”. Lastly, now supply chain has become a strategic industry from a supportive industry (Gundlach *et al.* 2006; Shahbaz *et al.* 2017). In the definition of supply chain management, the world flow is usual, most of the researchers use a three-fold flow to describe the supply chain management as the flow of information, the flow of material and the flow of finance (Chopra and Meindl 2006; Mentzer *et al.* 2008). Subsequently, research of Shahbaz *et al.* (2018) and Singh & Wahid (2014) relate supply chain management as a system that consist of people, information, organizations, activities, and resources which are being used to transfer goods or services from supplier to end-users with the help of some structured systems like purchasing, manufacturing, transportation, warehousing, planning and customer services.

2.2 Operational Performance

The performance is “A set of metrics used to quantify the efficiency and effectiveness of supply chain processes and relationships, spanning multiple organizational functions and multiple firms and enabling supply chain orchestration” (Maestrini *et al.* 2017). The aim of every organization is to enhance the performance but for improvement, performance must need to measure it accurately first (Panwar *et al.* 2018). Previously performance was measured by cost with the passage of time more financial indicators were added like return on asset, return on investment, sale and etc., (Anand and Grover 2015; Shahbaz *et al.* 2018). Only financial indicators are not enough to measure overall and accurate performance, consequently, with invent of balanced scorecard approach some operational indicators were added (Walukwe, 2016). Other approaches also added values in measuring supply chains like quantitative or qualitative measures, strategic, tactical and operational measures and etc., (Rasi *et al.* 2015; Shahbaz *et*

al. 2018). A comprehensive review and revealed that for the good performance measure all the members should be considered, performance measure should consider both financial and non-financial items, all the levels of the supply chain must be considered and all process of the supply chain should be included so the performance should be measured by operational performance.

2.3 Lean Practices

Lean practices empower organizations to produce superior, efficiency and developed customer satisfaction. It is defined as the “removal of echelons and functional interfaces to reduce time delays and information distortion” (Simangunsongy *et al.* 2012; Pradhan and Routroy, 2014). Formerly lean was applied to manufacturing but now it has extended its boundaries to the services sector (Chavez *et al.* 2015). There are plentiful lean practices mentioned in the literature review like 5s practices, Just in Time practices, total quality management (Walukwe, 2016), quick changeover systems, continuous improvements (Johnpaul, 2016).

2.3.1 Total Quality Management

Total quality management can be defined as “philosophy aimed at attaining business excellence through the tender of methods and technique” (Ngadiman *et al.* 2015). It aims to fulfill the customer’s requirements by emphasizing measurement, continuous improvement and control (Ross 1999). From the literature review, it has been identifying success factors for total quality management and their study have been replicated several times. After an extensive literature review, it has been revealed that 76 articles from different countries identify 18 universally applicable success factors for the implementation of total quality management (Knol *et al.* 2018; Nanda *et al.* 2013). The current study defines total quality management “processing as application tools and techniques as business performance”. Many studies proved that the relationship between total quality management practices and business performance is significant while few studies show that total quality management does not improve performance (Ahmad *et al.* 2015).

2.3.2 Using 5S Practices

5S’s is the lean concepts resulting from the Japanese words: “seiri (sort), seiton (set in order), seiso (shine or purity), seiketsu (standardize), and shitsuke (sustain)” (Ross, 2011). It focuses on neatness to attain a peaceful environment at the workstation. 5S include better ownership of the organizations by customers, employees and the administration of the organizations, and a good position of the organization (Walukwe, 2016). It includes the personnel with an assurance to openly device and practice cleaning. Unifying and cleaning the workstation assistances the employees to discover problems. Refusal of 5S can mark 5D (defects, declining profits, delays, demoralized employees and dissatisfied customers) (Walukwe, 2016). Additionally, it has proved that 5S has a significant influence on performance (Panwar *et al.* 2018). Meanwhile, another study reveals that 80% of service organizations are taking benefits from 5S (Johnpaul, 2016).

3. Methodology

A five-point Likert scale questionnaire is used for this study. The questionnaires distributed to the distributors, retailers, and suppliers who affiliated in the construction supply chain industry with the Federal Government of Pakistan. The respondents are from all levels of management such as strategic level, operational level, and technical level of the construction supply chain. The questionnaire collected through a self-administered survey and email from five regions namely Punjab, Sindh, Khyber Pakhtunkhwa, Islamabad Capital Territory, and Gilgit Baltistan. There are 367 valid questionnaires received and used for the multiple regressions analysis and Pearson correlation analysis through SPSS version 23. The lean practices variables and items used for the questionnaire are presented in Table 1.

Table 1 - The lean practices variables and items

Variables	Items	Source
Total quality management	Printers/Technicians are involved in solving key production related issues	Johnpaul,2016
	Production equipment is maintained as per the schedule	
	Operators are empowered to help maintain their equipment	
	Quality issues are specifically targeted with improvement projects fixated on removing the root cause	

Quick Changeover	Cross-functional teams work on resolving recurring problems.	Johnpaul,2016
	Less equipment downtime is a result of fast changeovers	
	More frequent product changes are enabled by fast changeovers	
	Low inventory levels are a result of small lot sizes	
5S practices	Consistency and quality are improved by the standardized changeover	Kauppi <i>et al.</i> 2016
	Items are arranged to permit ease of access to needed materials	
	Disposal area for the used material is clearly marked	
	Color coding is used for ease of identification	
Operational Performance	Items not needed have been eliminated from the work area	Kauppi <i>et al.</i> 2016
	Quality performance	
	Flexibility performance	
	Customer service	
	Delivery speed	
	Cost performance	

Based on Table 1, this study empirically analyzes the impact of total quality management, Using 5S practices, Quick change over to Operational Performance.

4. Results and Analysis

This study examines the effects of lean practices on operational performance towards the supply chain of the construction industry. Figure 1 shows that the majority of the respondents about 54% from the Islamabad Capital Territory. This indicated that more than 50% of respondents are from the capital city of Pakistan. Numerous construction suppliers are located in the city due to the logistic issue.

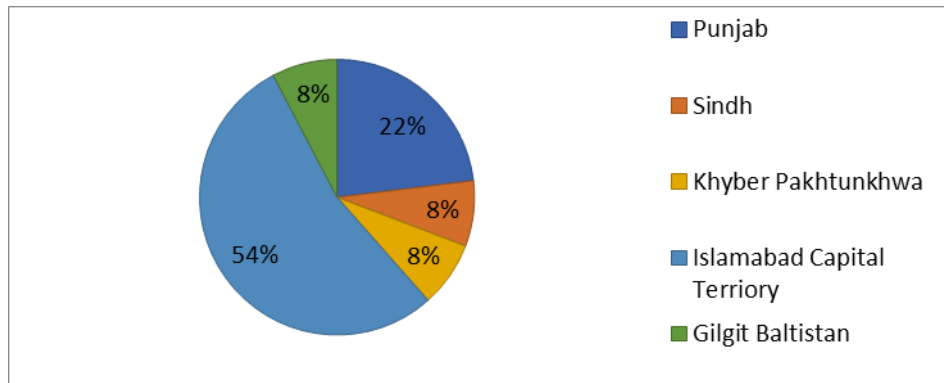


Fig. 1 - Respondents according to their regions

Reliability is measured using the Cronbach Alpha coefficient. Table 2 presents the value of Cronbach Alpha coefficient. The value of Cronbach Alpha coefficient is above 0.7 to all the four variables as showed in Table 2. Therefore, this indicates that the questionnaire used for this study is reliable.

Variable	Cronbach Alpha coefficient
Total Quality Management	0.876
Using 5's Practices	0.877
Quick Change Over	0.899
Operational Performance	0.894

Correlation (r) is a relationship among variables; one tail Pearson correlation has been calculated to determine the relationship between lean approaches and operational performance. Analysis of correlation showed in Table 3, identified that Total Quality Management and Operational Performance are strongly correlated with $r = 0.801$. Hence, there is a significant relationship between these two variables. Meanwhile, the correlation of Using 5's Practices and Quick Change Over is indicated the positive relationship among variables.

Table 3 - Pearson Correlation Results

Variables		Total Quality Management	Using 5's Practices	Quick Change Over	Operational Performance
Total Quality Management	Pearson Correlation	1	0.750**	0.684**	0.801**
	Sig. (1-tailed)	-	0.000	0.000	0.000
	N	367	367	367	367
Using 5's Practices	Pearson Correlation	0.750**	1	0.652**	0.762**
	Sig. (1-tailed)	0.000	-	0.000	0.000
	N	367	367	367	367
Quick Change Over	Pearson Correlation	0.684**	0.652**	1	0.676**
	Sig. (1-tailed)	0.000	0.000	-	0.000
	N	367	367	367	367
Operational Performance	Pearson Correlation	0.801**	0.762**	0.676**	1
	Sig. (1-tailed)	0.000	0.000	0.000	-
	N	367	367	367	367

** . Correlation is significant at the 0.01 level (1-tailed).

Furthermore, multiple regression analyses carried out for determining the degree of strength and the direction of the linear relationship among research variables (Nanda *et al.* 2013). Regression analysis in Table 4 indicates the relationship between variables. Total Quality Management, Using 5S Practices and Quick Change Over regressed against Operational Performance (criterion/dependent variable).

Table 4 - Regression Analysis Results

Variables	Standardized		
	Coefficients	t	Sig.
	Beta		
Total Quality Management	0.625	7.134	.000
Using 5S Practices	0.524	8.020	.000
Quick Change Over	0.521	4.571	.000

Based on Table 4, Beta coefficient values indicate the contribution of the individual predictor to the Operational Performance (criterion/dependent variable). The beta value for total quality management is 0.625. This means when one unit increase in Total Quality Management, the overall performance of lean operations will increase by 0.625. The significance was found between Using 5S practices and Operational Performance and indicates about beta value 0.524 which shows the relationship between them. The beta value of Quick Change Over is 0.521 which means when one unit increase due to Quick Change Over with members, the overall performance of lean operations will increase by 0.521. There is a significant relationship between these three variables of Total Quality Management, Using 5S Practices and Quick Change Over with lean operations. The significance of all the independent variables was found $P < 0.05$, which is 0.000. The result shows the variables of total quality management, Using 5S practices and Quick change over jointly explain the variance of the dependent variable.

5. Discussions

This study focuses on using relations between Total Quality Management, Using 5S practices, Quick Change Over and Operational Performance in the context of the construction supply chain. The study results show that total quality management has a positive impact on the variable operational performance using, Using 5S practices and quick change over. These results are reliable with reliable pressure operation literature (Ahmad *et al.* 2015). This study shows that the process of implementation of the construction supply chain is also an important example, such as other developed countries. It will have to benefit both of the individual, suppliers and buyers' organizations and other researchers. Next, applying lean operations can help to boost operational performance. Managers of the supplier firm need to collaborate

with the managers from the buyer firm in terms of making several operational decisions. Moreover, connecting managers across functional and organizational boundaries and providing them with relevant, accurate, and timely information reduces temporal and spatial distance enabling them to make better, more collaborative decisions. Recent technological advancements have dramatically increased companies' ability to connect.

This study proposes that total quality management, Using 5S practices and quick change over are the relevant factors and suggest that operational performance is the most important one. This study also provides an empirical explanation that identifies the positive and important relationship between lean approaches and operational performance within the context of construction supply chain organizations. Thus, managers looking for proficiency and efficiency improvements should consider a set of lean operations that could help them to expand their lean abilities and in turn their performance. The operational management provided in this study can be suitable for managers to evaluate their current performance of the construction supply chain industry. Organizations are strongly interested in developing good performance and should develop innovative strategies. The managerial contribution of this study demonstrates why careful consideration should be applied when deciding which lean operational approaches should be developed. Firms that manage to achieve this relationship benefit greatly by improving their operating margins, cost efficiencies, waste reduction, agility and time-to-market, and overall gain sustainable competitive advantages. This study also demonstrates that such a relationship cannot be achieved in isolation at a firm-level alone.

6. Conclusions

This study has considered three approaches to Total Quality Management, Using 5S Practices and Quick Change Over. It has been proved statistically that all approaches have positive and significant effects on Operational Performance. Furthermore, this study is aligning with previous studies that have been revealed that lean practices have positive effects on performance in many industries and demographics. Thus, it has been found through lean practices performance can be increased in the construction supply chain of Pakistan. Therefore, this study will help managers to know the advantages of lean practices and to recognize which approach is better than other approaches in the supply chain industry.

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