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THE IMPACT ON LEAN PRACTICES BY OPERATIONAL FACTORS: EVIDENCE FROM THE MANUFACTURING FIRMS OF PAKISTAN

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Abstract:

Purpose: The study has aimed to identify the effect of lean practices on the operational performance of manufacturing firms of Pakistan.

Design/Methodology: Using positivistic deductive approach, the study has collected 211 responses from the supply chain professionals of manufacturing firms of Karachi, Pakistan using purposive sampling technique. PLS-SEM has been employed for data analysis using SmartPLS version 3.2.8.

Findings: The study has manifested that lean practices can enable manufacturing firms of Pakistan to improve their operational performance.

Implications: Kanban is one of the most effective and tested methods to do this. Kanban is a mechanism that controls the flow of products within a supply chain by using visual signals (cards). There is a Kanban card attached to each object, container, crate, or pallet. The Kanban card details the products and amounts to purchase, so the factory floor may request the right parts. Workers take the card and give it to the department of sales.

Originality: The study has not been employed in the Pakistan context while due to lack of lean application in the industrial sector of Pakistan; the implications may encourage organizations towards lean practices. Moreover, the lean practices can enable large-scale manufacturing firms to improve their performance in current downturn.

Key Words:

Lean Practices, Operational Performance, Lean Formation Higher-Order, PLS-SEM, Pakistan.

1. Introduction

In Japan, the Toyota Production System (TPS) was first established by Toyota. This production system introduced a new approach for manufacturing in the industries of USA known as lean manufacturing system (Krafcik, 1988). Further this new approach of manufacturing was adopted in other developed nations too. This lean production mechanism and research over it has been given attention in recent days with respect of the small and medium enterprises working in developing nations like India (Yadav *et al.*, 2019).

There are certain studies in past literatures that have focused on the SMEs (Gupta & Jain, 2013; Kumar *et al.*, 2006; Panizzolo *et al.*, 2012; Upadhye *et al.*, 2010). These research papers had basically focused on the implementation level and the introduction of the analytical and presentational models. It has been found in previous studies that the main objective of lean manufacturing mechanism is to grow the customer value to its maximum by reducing the overall waste(Godinho Filho *et al.*, 2016). Further the ultimate goal of an organization to adopt this lean manufacturing system is to increase productivity, improve the overall quality, reduce the cost as well as the lead times (Jasti & Kodali, 2015). According to Negrão *et al.* (2017), most of the studies by now have major focus on lean mechanism's technical aspects (such as the implementation practice and the impact on the organizational performance, rather than having focus on the concerned people and their related problems). The recent studies have moved their focus to the segment of "why" to adopt lean working that address the practices of HRM (Vivares-Vergara *et al.*, 2016). Such as Bonavia and Marin-Garcia (2011) found in their study that most of the researchers focus on identifying the requirement of Human Resource Management related practices to maintain the adoption of lean management with the passage of time. However a very limited focus has been given on if the HRM practices can have significant effects on Lean practices (Sparrow & Otaye-Ebede, 2014). Thus, this research has changed the dimensions of focus and has examined the results of lean management practices on the structural performance of SMEs working in Pakistan.

Lean manufacturing system has been considered now as one of the most important manufacturing mechanisms in the industries (Secchi & Camuffo, 2016). This mechanism has been adopted by many companies all over the work and many different researchers have focused on the investigation of the association among the usage of lean Production system and the company's performance in different countries of the world (Sparrow & Otaye-Ebede, 2014). But the literature related to the results of adoption of lean production mechanism on the operations of SMEs is very limited. Thus it is strongly recommended to have further investigation on the association among the adoption of lean manufacturing mechanism and the

SMEs' operational progress (Panwar *et al.*, 2018). Though there are many studies that have considered on the relevant important benefits of espousing this lean creation system in the large business sectors (Belekoukias *et al.*, 2014; Bevilacqua *et al.*, 2017; Shah & Ward, 2003, 2007). However there exists a great room of uncertainty related to the effects of this lean manufacturing system in the small & medium enterprises (SMEs). There is a need to have complete understanding of the benefits related to the implementation of lean production systems and this system needs to be evaluated in terms of SMEs (Dora *et al.*, 2016).

As the world organizations keep on finding different ways to attract more customers towards their product or service and to sustain the existing customers too, they keep developing different strategies for this reason. Lean manufacturing system is also one of them. Though there has been a considerable work on the lean management however there remained a gap in terms of its adoption among SMEs. Thus, this study would be helpful to analyze that how this implementation of lean can affect the organizational performance among SMEs of Pakistan.

2. Literature Review

2.1 Operational Performance

There are some projects in the organizations that are of complex nature since they involve services of different specialists. Just like the projects at airport where the specialists are required from private and public sector to gain required objectives. Such projects sometimes do not follow the set procedures. Therefore, it is significant to analyze the act and practices of the organizations in such projects (Onofrei *et al.*, 2019). Thus Herrera *et al.* (2018) developed a research model to identify the functions of the organizations and its performance that are developed in the project designs. For this purpose, they investigated nine different airport projects at Chile that involved exhaustive management. It was found in this study that in studied projects, it could be recognized that the higher development practices are the requirement managements and the clients' systematic participation, while the bad performance was observed where the builders' early involvement was observed. Another study by Onofrei and Fynes (2019) investigated the model that includes different investments of the organizations and the production level of the organizations in order to recognize the successful performance of the organizations. By using the data of Global Manufacturing Research and the sample data of 17 countries' 844 plants, it was found that the investment in different strategies of the organizations bring improvements in the production and thus overall performance of the organization is improved. With higher investments in the production sector by the organizations

generate quality practices. Thus it is identified that for higher production and performance, the prerequisite is to have better quality production (Bevilacqua *et al.*, 2017).

2.2 Lean Manufacturing Operations

The "Lean Manufacturing Operations" is an organizational approach that is used to improve overall processes on the basis of a complex system interconnected practices of social and technical methods. Much debate has been conducted on the topic of lean management in organizational culture (Bai *et al.*, 2019). Bortolotti *et al.* (2015). Did a study in order to add on this debate by studying if lean management's successful execution is organized by particular profile of organizational culture, and if it adopts practices of soft lean management extensively. By utilizing the multi group approach, they studied the data of projects related to high performance manufacturing. Analysis results showed that some particular profiles of organizational culture effects on the successful implementation of lean (Chavez *et al.*, 2015). Another study by Bhutta *et al.* (2017) investigated the successful adoption and implementation of practices of lean controlling in different Pakistani industrial sectors. For this, they collected data of total 100 companies working under 5 industries. They examined if any disparity existed in the lean practices implementation and also they worked on providing a measure for that disparity. They studied collected data through different descriptive methods of statistics. The analysis outcomes showed that there is high level Lean practice adoption and implementation in the industrial sector of Pakistan, however still there were some areas that need higher level of acceptance (Dey *et al.*, 2019).

H1.Customer involvement significantly related to lean practices.

H2.Employee involvement significantly related to lean practices.

H3.Pull system significantly related to lean practices.

H4.5S significantly related to lean practices.

H5.Total productive maintenance significantly related to lean practices.

H6.Statistical process control significantly related to lean practices.

H7.Single minute exchange of dies significantly related to lean practices.

H8.Production leveling significantly related to lean practices.

2.3 Lean Practices and Operational Performance

In order to use lean manufacturing system in the organizations, it is necessary to identify how and where the practices of lean management are required most to affect the business performance and the overall manufacturing. This study is crucial when lean manufacturing

system is taken in the production arrangement (Yadav *et al.*, 2019). Panwar *et al.* (2018) conducted a study to investigate that how organizational performance is increased with the support of lean management operations in the industries. For this purpose, they conducted a survey with Indian industries. The findings of this research showed that there is an affirmative association between the lean practices' management and the overall organizational performance including the on-time delivery, productivity, management of waste, reduction in inventory, decrease in costs and others.

Another research by Sharma *et al.* (2015) examined the effects of lean management practices on the organizational performance. In this study they focused on the machine apparatus industry and identified the lean practices that could affect performance significantly and positively. This was an exploratory research that based on the Indian national capital region. From the machine tool industry, directors, managing directors and the managers were approached for interviews. Through multiple regression analysis it was revealed that there are two criteria of lean practices including the cross organizational cross functional designs and the suppliers' strategic partnership and also the teams development that have substantial impact on the key measures of performance. Further the study found some lean criteria that have negative effects on the competition of the firms (Onofrei & Fynes, 2019; Onofrei *et al.*, 2019).

Negrão *et al.* (2017) produced an extensive literature review of total 83 papers that worked on the acceptance level of lean manufacturing practices all over the world. These studies further developed relationship between these manufacturing operations and the companies' performance. The analysis outcomes of these past papers showed that the implications of lean manufacturing operations is still discussed in fragmented way, through there is a systematic relationship necessary for lean manufacturing. Total forty one papers from the studied one showed that there is a positive impact of lean practices in one economical, environmental as well as operational performance of the organizations. Five studies out of them showed that there are some lean practices that leave negative impact on the economical and operational performance of the organizations (Zhan *et al.*, 2018).

Bevilacqua *et al.* (2017) combined the interviews conducted in the fields along with the theoretical findings and literature reviews related to the association between techniques of lean manufacturing and the operational performance of the organizations. They developed a conceptual model to study the result of these lean practices including human resource management, supplier management, total quality management and the just in time, on the operational progress of the organizations including product innovation, product mix variety and the effectiveness in time. The hypothesized relationship was studied using structural equation

modeling. The analysis results showed that the responsiveness in operations has partial relationship with the strategies of lean manufacturing system of the organizations. Further it was found that the applications of lean practices are negatively affected by the variety of product mix and also by the innovation, while it is positively affected by the variables of time effectiveness (Panwar *et al.*, 2017).

Lean practices have significant effect on operational performance.

3. Methodology

3.1 Study Design

The study has used positivistic philosophical approach to research for comprehending the quantitative research strategy. The study has identified management problem for refining their operational progress through lean practices; therein, the objective of the study is to improve the knowledge-base (Pathirage *et al.*, 2008) of the current performance of the manufacturing firms of Karachi, Pakistan. Moreover, the objectivity of understanding the perspective of the supply chain professionals of manufacturing firms to enhance their operational performance; the close-ended rating scale instrument was used (Welman *et al.*, 2005). However, the study has

undertaken pre-existing scenario and circumstances for improving the knowledge-base (Kumar & Phrommathed, 2005); thereby, explanatory type of investigation was considered. In addition, the study was deductive in nature due to the fact that it has narrowed the scope of the entire supply chain operations and quality management to lean practices specifically while it has focused on specific outcome of the improvement of operational performance of manufacturing firms of Karachi, Pakistan (Blessing & Chakrabarti, 2009).

3.2 Sampling Design

In the current time, manufacturing sector of Pakistan has somewhat declined its growth to a significant rate of 13 percent that was hovering around 13.5 percent in the past decade. However, the large-scale manufacturing firms were contributing 10.2 percent in GDP while the contribution of small-scale manufacturing firms was 2 percent in the economic development of Pakistan (Economic Survey of Pakistan, 2018-19). Nevertheless, the significance of manufacturing sector of Pakistan cannot be neglected in such dramatic decline phase. Therefore, the study has undertaken the role of lean practices on the operational performance of manufacturing firms of Karachi, Pakistan. The core reason behind specifically selecting Karachi-based manufacturing firms is the accessibility to larger population of supply chain professionals and personally collects responses.

However, due to unknown size of the population; that is, total number of supply chain specialists in the manufacturing firms of Karachi, Pakistan, the study has used nonprobability purposive sampling technique. In the purposive sampling technique, the selection of the respondents based on the rationalized opinion, knowledge and expertise of the researcher to collect data from the most appropriate respondents of the population (Gomm, 2008). Moreover, the study has used Soper (2019) online sample size calculator for estimating minimum sample size; therein, anticipated effect size of 0.30 and statistical power of 0.80 was used and in case of ten latent constructs and total 41 observed variables in the model, the study has estimated minimum sample of 190 responses. Thus, the study has distributed 250 questionnaires to the supply chain professionals of manufacturing firms of Karachi, Pakistan while only 227 responses were returned and only 211 responses were found valid with the response rate of 90.8 percent.

3.3 Instrument

The study has developed five-point Likert scale questionnaire for collecting responses from the population denoting 1 as strongly-disagree and 5 as strongly-agree. The methods of the paradigms were adapted from Yadav *et al.* (2019) comprising four measures in customer

involvement, four measures in employee involvement, four measures in pull system, five measures for 5S, four measures for total productive maintenance, four measures for statistical process control, five measures for single minute exchange of dies, six measures for production leveling, and five measures for operational performance *(see appendix)*. However, some demographic items were also included in the instrument entailed as firm type, firm size (estimated using number of employees), professional experience of the respondents, and academic qualification.

3.4 Data analysis

Since the inception of statistical influential analysis, the debate was initiated from the application of multiple regression analysis and ultimately reaches the complex and multifaceted discussion on structural equation modeling (Hair *et al.*, 2016). However, when it comes to structural equation modeling, researchers have mainly two categories known as covariance-based structural equation modeling and partial least square structural equation modeling (Hair *et al.*, 2011). It is main here to differentiate between the two types in order to provide the rationale of using appropriate statistical inferential technique. Most importantly, the application of CB-SEM is to test the theory while VB-SEM (also known as PLS-SEM) has the objective to predict dependent variable by explaining complex theoretical foundations (Afthanorhan, 2013; Astrachan *et al.*, 2014). Moreover, PLS-SEM can be used for smaller sample size compared to CB-SEM. PLS-SEM also helps to determine advanced methodologies for discriminant validity including HTMT ratio and crossloadings (Sarstedt *et al.*, 2014; Wong, 2013). VB-SEM also supports non-normal distributed data and use nonparametric techniques for analyzing results and findings (Hair *et al.*, 2013). Therefore, the study has used PLS-SEM for undertaking the research topic using SmartPLS version 3.2.8.

4. Results and Findings

Following are the demographic profile of the respondents that have contributed in the study.

Table 1: Demographic Profiles (n = 211)

		Frequency	Percent
Firm Type	Textile	159	75.4
	Automotive	15	7.1
	Pharmaceutical	14	6.6
	Others	23	10.9

Firm Size (No. of Employees)	<250	12	5.7
	250-1000	31	14.7
	1001-2000	32	15.2
	>2000	136	64.5
Professional Experience	< 3 years	101	47.9
	3-5 years	55	26.1
	5-8 years	32	15.2
	8-10 years	7	3.3
	>10 years	16	7.6
Academic Qualification	Undergraduate	22	10.4
	Graduate	61	28.9
	Masters	120	56.9
	Others	8	3.8

Following table 2 provides result of measurement model of the first-order constructs in the structural framework of the study. In this regard, the following table comprised of factor loadings and their significance values, Cronbach's alpha, composite reliability (CR), average variance extracted (AVE), path coefficient of the construct to its higher-order formative construct and its significance value. The measurement model in table 2 was estimated using PLS algorithm and PLS bootstrapping at 5000 subsamples (Hair *et al.*, 2016).

Table 2: Measurement Model

Measures/Construct	Loading	Alpha	CR	AVE	Path
CI1 <- Customer Involvement	0.962*	0.970	0.977	0.915	0.124*
CI2 <- Customer Involvement	0.932*				
CI3 <- Customer Involvement	0.975*				
CI4 <- Customer Involvement	0.956*				
EI1 <- Employee Involvement	0.914*	0.804	0.870	0.628	0.226*
EI2 <- Employee Involvement	0.769*				
EI3 <- Employee Involvement	0.710*				
EI4 <- Employee Involvement	0.761*				
OP1 <- Operational Performance	0.958*	0.944	0.964	0.899	NA
OP2 <- Operational Performance	0.940*				

OP3 <- Operational Performance	0.946*				
PL3 <- Production Leveling	0.941*				
PL4 <- Production Leveling	0.937*	0.877	0.924	0.804	0.186*
PL5 <- Production Leveling	0.805*				
PS1 <- Pull System	0.752*				
PS2 <- Pull System	0.938*	0.896	0.929	0.767	0.266*
PS3 <- Pull System	0.939*				
PS4 <- Pull System	0.860*				
SME3 <- Single-Minute Exchange of Dies	0.950*	0.796	0.903	0.823	0.070*
SME4 <- Single-Minute Exchange of Dies	0.863*				
SPC1 <- Statistical Process Control	0.887*				
SPC2 <- Statistical Process Control	0.914*	0.918	0.943	0.805	0.278*
SPC3 <- Statistical Process Control	0.955*				
SPC4 <- Statistical Process Control	0.828*				
SS1 <- 5S	0.914*				
SS3 <- 5S	0.939*	0.906	0.941	0.841	0.174*
SS4 <- 5S	0.897*				
TPM2 <- Total Productive Maintenance	0.937*	0.832	0.922	0.855	0.026**
TPM3 <- Total Productive Maintenance	0.913*				

** at significance of 5 percent; ** at significance of 10 percent*

The above table showed that all measures of each first-order latent construct have factor loadings higher than 0.70 and statistically significant; therefore, the recommended threshold for construct development by Hair *et al.* (2011). Moreover, Hair *et al.* (2013) suggested that Cronbach's alpha should be higher than 70 percent, CR should be higher than 80 percent, and AVE should be higher than 50 percent for considerable degree of convergence and therein, above table showed that all latent constructs have achieved aforementioned thresholds. Lastly, the formative higher-order construct of lean practices was manifested by the combination of eight first-order latent constructs and above table showed that all first-order latent constructs of lean practices was found positively significant at 90 percent confidence interval (Hair *et al.*, 2016; Hair *et al.*, 2011, 2013; Hair *et al.*, 2014; Sarstedt *et al.*, 2014).

Furthermore, table 3 provides result of HTMT ratio for discriminant validity; that was proposed by Henseler *et al.* (2016); Henseler *et al.* (2015). In HTMT ratio, all first-order latent constructs

have HTMT coefficients below the recommended threshold of 0.95 (Henseler *et al.*, 2015). Thereby, discriminative validity using HTMT ratio has been achieved.

Table 4: Hypothesis-Testing using Path Analysis

	Estimate	Std. Dev.	T-Stats	Prob.
Lean Practices -> Operational Performance	0.894	0.015	60.568	0.000

R-Square = 0.800; Q-Square = 0.676

It has been manifested that lean practices have significantly positive effect on operational performance in the manufacturing firms of Karachi, Pakistan. This result was supported by numerous past studies (Bai *et al.*, 2019; Negrão *et al.*, 2017; Onofrei *et al.*, 2019; Yadav *et al.*, 2019) postulating that lean practices may encourage the cost curtailment behavior of the firm in the economic downturn (Panwar *et al.*, 2018; Panwar *et al.*, 2017) while it facilitates effective resource allocation and utilization (Bhutta *et al.*, 2017) to optimize the overall outcomes to achieve the ultimate organizational goals (Bortolotti *et al.*, 2015; Chavez *et al.*, 2015).

Table: Discriminant Validity using Heterotrait-Monotrait (HTMT) Ratio

	5S	CI	EI	OP	PL	PS	SMED	SPC	TPM
5S									
Customer Involvement	0.162								
Employee Involvement	0.502	0.192							
Operational Performance	0.617	0.191	0.926						
Production Leveling	0.469	0.153	0.536	0.794					
Pull System	0.450	0.158	0.892	0.860	0.694				
Single-Minute Exchange of Dies	0.348	0.945	0.339	0.337	0.238	0.294			
Statistical Process Control	0.875	0.203	0.718	0.781	0.520	0.615	0.388		
Total Productive Maintenance	0.038	0.919	0.184	0.076	0.086	0.094	0.803	0.105	

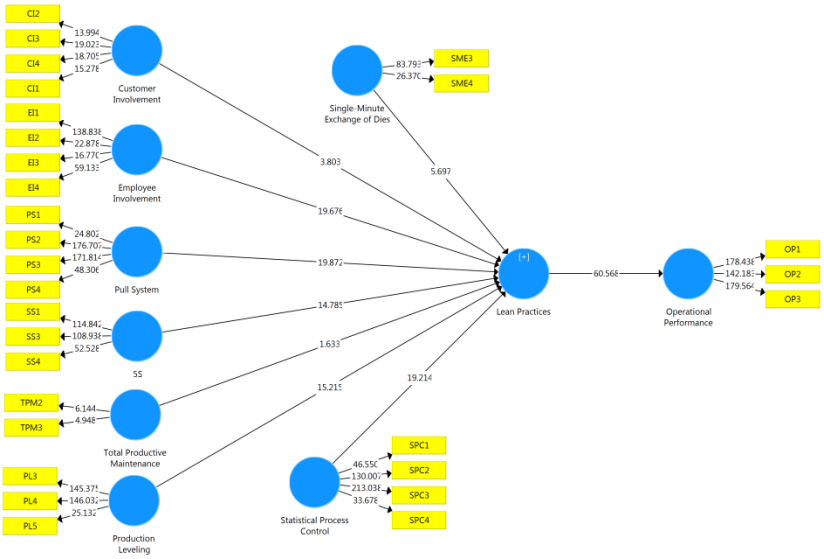

Figure 2: PLS Bootstrapping using SmartPLS version 3.2.8

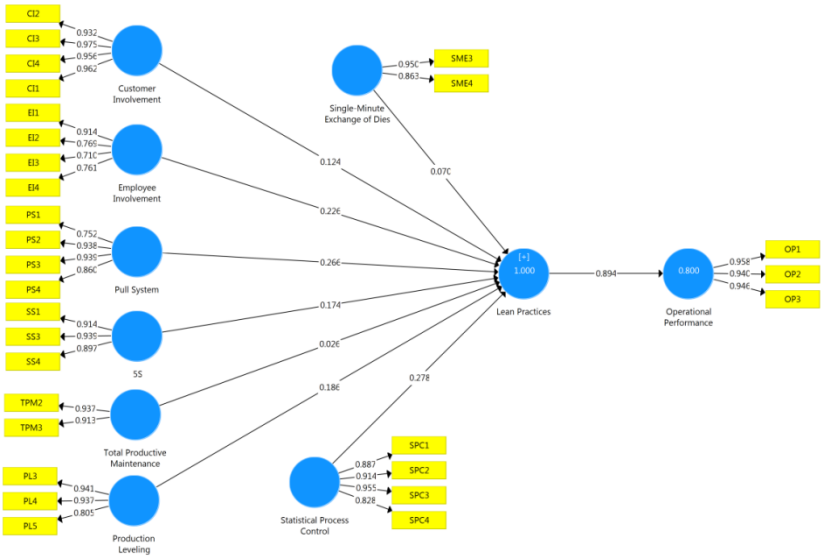

Figure 3: PLS Algorithm using SmartPLS version 3.2.8

5. Conclusion and Recommendations

The paper's goal was to calculate the level of lean acceptance in businesses and to check its effect on organizational efficiency. The present research determines that there is a significant and affirmative relationship between lean practices and operational performance. The study concludes that by following lean practices businesses can reduce inefficient processes and improve their performance. The lean practices save companies money and improved overall profitability by dropping waste and enlightening customer gratification. The lean procedure is based on continuous improvement. Furthermore, it is also concluded that Lean is a major activity requiring inclusive planning and full workforce assurance in order to increase

operational performance. It also helps the company in focuses on refining products and services constructed on the value & desire of customers. Moreover, it also concludes that Easy manufacturing is a reorganized method using a pull system to make customer-based products. Additionally, the quality of business practices has to be constantly tracked in order for the lean approach to be efficient. Statistical Process Control (SPC) and Overall Equipment Effectiveness (OEE) monitoring are binary tools that support businesses assess progress and recognize regions of concern. Lastly, this study supports researchers ' common perception that lean acceptance has a positive effect on the organization's organizational efficiency

There are some recommendations present in this current study for managers that help them in increasing operational performance by following lean practices. Firstly, it is recommended to manager to install a pull system. Kanban is the most favorable, effective, and tested methods to do this. Kanban is a mechanism that controls the flow of products within a supply chain by using visual signals (cards). There is a Kanban card attached to each object, container, crate, or pallet. The Kanban card details the products and amounts to purchase, so the factory floor may request the right parts. Workers take the card and give it to the department of sales.

Secondly, continuous improvement helps the lean procedure by developing a culture in which every employee from the CEO to the assistant in the manufacturing floor looks for alternatives to progress the business. Specific modifications are usually relatively small; however, the adjustments result in significant results over time. It's important to share how the business has been improved by changes. This will display the program's effectiveness and enable employees to come forward with new ideas. Through allowing workers to adopt their own innovations, organizations can also encourage participation. It shows workers that they are reliable and makes Kaizen a vital part of the culture of the company.

Moreover, visual contact is a key element that can enable companies to create an era of continuous improvement. Intentionally placed symbols or indicators help convey process adjustments, meaning that workers can switch smoothly from one job to another, even when processes shift. Continuous improvement will deliver the framework necessary to gear-up the lean cycle once created.

Furthermore, SPC is the mechanism for quality regulator that can be used by indicators to observe and control procedures. Using a monitor map, SPC can be applied. A monitoring panel can be used by companies to record data and look when systems takes time in working. Once a concern has been established, the problem can be solved by staff as well as any other issues that arise.regular OEE measurement will help businesses track improvement effectiveness, identiy issues when they happen, and classify areas that require instant improvement.

Beyond Kaizen and Kanban, companies can use 5S to promote easy production and continuous improvement in their execution. It can be accomplish by deleting unneeded objects from the office, For comfort and performance, every work area is coordinated, employees make their workplace clean every day to assist identify possible problems and organize the environment, Developments are recorded so that they can be replicated across the workforce, and in last Each 5S move is repeated every day. Lastly, the supervisors should however assess the suitability of these procedures for their company's characteristics.

Some of the future recommendations are: firstly, while our sample size was sufficient and descriptive, it is limited to Pakistani context. In a more diverse context, further research is required to confirm the generalization of the results. Secondly, effect of lean adoption is not only restricted to organizational efficiency; it also increases socioeconomic, social and environmental results. The observational research can therefore be expanded to validate the effect of lean on sustainability.

Further this research would be helpful for the researchers as they would be able to identify how this lean management works on the SMEs in the developing sector too as the overall research on lean management have major focus on the developed sector of the world. The researchers would also be able to explore how frequently the small and medium enterprise adopt this lean manufacturing system in their organizations and in the developing countries and how much they care to manage it within the organizational practices.

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Measures

Customer involvement

We are in close contact with our customers.

Customers give feedback on quality and delivery performance.

Customers are actively involved in current and future product offerings.

Customers frequently share demand information.

Employee involvement

Shop floor employees are actively involved in problem solving.

Shop floor employees are actively involved in process improvements.

Shop floor employees regularly provide suggestions for improvement.

Shop floor employees undergo cross-functional training.

Pull system

Production is pulled by shipment of finished goods.

Production at workstations is pulled by the demand of the next station.

We use Kanban, squares or containers of signals for production control.

We use a pull system to control the production rather than a schedule prepared in advance.

5S

Only the materials which are actually needed are present in the work area.

Only tools and hand tools which are needed are present in the work area.

Locations for all production materials are clearly marked out and the materials are stored in the correct locations. Areas for WIP (work-in-process parts) are clearly marked.

Work areas, storage areas, aisles machines, tools, equipment and offices are clean/neat and free of safety hazards.

Regularly scheduled housekeeping tours and periodic self-assessments (5S audits) are conducted.

Total productive maintenance

We maintain all our equipment regularly.

We maintain records of all equipment maintenance activities.

We ensure that machines are in high state of readiness for production at all the time.

Operators are trained to maintain their own machines.

Statistical process control

Charts showing defects are used as tools on the shop floor.

We use diagrams like cause & effects (fishbone) to identify causes of quality problems

We conduct process capability studies before product launch.

We use statistical techniques to reduce process variance.

Single minute exchange of dies

We are working to lower set-up time in our plant

We have short set-up times for equipment in our plant

Operators perform their own machines set-ups.

Operators are trained on machine set-up activities.

We emphasize the need to place all tools in a convenient area to the operator.

Production leveling

We mix production on the same machines and equipment..

We emphasize the need for an accurate forecast to reduce variability in production.

Each product is produced in a relatively fixed quantity per production period.

We emphasize the need to equalize workloads in each production process.

We produce by repeating the same combination of products from day to day.

We always have some quantity of every product model to respond to variation in customer demand.

Operational performance

We have low inventory levels (raw material, WIP and finished goods)

We have low defect levels.

Our productivity is high.

We have low production waste.

Our production costs are predictable.