

An Investigation of Lean Manufacturing Implementation in Textile Industries of Pakistan

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Abstract

This survey based study explored the implementation of lean manufacturing practices in textile industries of Pakistan. A total of 76 responses were received. The results of the study showed that the textile sector is at the beginning stage of lean implementation – more than half of the surveyed companies were in transition to implement lean. The most important driver to implement lean was found to be organization's continuous improvement program followed by the drive to focus on customers, and desire to use best practices. The respondents perceived cost reduction to be the biggest benefit that can be achieved by implementing lean, followed by customer satisfaction, and improved delivery time. Among tools and techniques 5S, quality control circles, kaizen and SMED were used extensively. Manufacturing planning and control was not formally implemented. Human resource related factors were perceived to be crucial to effectively implement lean. Level of implementation was found to have a significant relationship with the size and the type of company and not with the age of the company. Lack of awareness to implement lean, company culture, lack of communication, and employee resistance were the main barriers faced by the sample companies during the implementation of lean.

Keywords: Lean implementation; textile industry; drivers and benefits of lean; lean tools; barriers to lean

1. Introduction

Customer satisfaction is the main focus of all organizations (Ferdousi and Ahmed, 2009). With increased awareness customers are demanding more variety at less cost but with high quality and at fast delivery (Farhana, 2009). Added to this challenge is the ever increasing competition due to globalization. As a result organizations are looking for ways of spending less and producing more. Use of lean production is a proven way to cope up with this challenge.

Textile sector of Pakistan is considered as backbone of economy and is a major contributor both in terms of exports and employment. It contributes 8.5 percent to the GDP and employs over 40% of the manufacturing sector workforce (APTMA, 2015). Pakistan produces a variety of textile products, and is among top five producers and consumers of cotton (JCRVIS, 2015) and is the 8th largest exporter of textile products (PACRA, 2015). USA and EU are the demand drivers of textile products whereas there is a major competition between Pakistan, Bangladesh, China, and India in international market. In past few years, however, Bangladesh, China, and India have become more competitive in both quality and price than Pakistan. From the total volume (US\$18 trillion per annum) of world textile trade, Pakistan's share is less than one percent.

Implementation of lean production principles can help this sector emerge among this competition and regain its position in international market. Implementing lean not only improves customer satisfaction but also overall organizational efficiency and effectiveness (Ferdousi and Ahmed, 2009). However, little work has been done to implement lean in Pakistan's textile sector. Most work has focused on just a set of tools of lean, and a holistic approach has been lacking. National Productivity Organization (NPO) with the cooperation of Asian Productivity Organization (APO) Japan and in collaboration with Small and Medium Enterprises Development Authority (SMEDA) organized many training programs in order to introduce the lean manufacturing concepts. The ultimate challenge has been to change the mindset of top management and increase awareness about lean practices (NPO, 2010). A comprehensive study analyzing the extent of implementation of lean principles, their impact on organizational performance, and barriers to implementation is lacking. The purpose of this study was to fill this gap and to present a clear evidence on current status of lean implementation, its benefits, and challenges to implementation.

2. Literature Review

James Womack et al. (1990) used the term “lean production” in their book that depicts the manufacturing concept set up by the Toyota Production System (TPS) that defined the famous seven types of waste. TPS proposed a number of highly developed manufacturing methods to minimize these wastes (Ohno, 1978; EPA, 2003). Lean production is considered as the best production system of 21st century (Nasser et al., 2009). It requires least investment as compared to other manufacturing systems (Nasser et al., 2010) – one of the most important reasons that makes it an ideal candidate for almost all types of organizations irrespective of their type and size.

Lean is a systematic approach. Its main focus is on continuously improving quality, cost, delivery, and safety and it is achieved by eliminating waste, creating flow, and increasing the efficiency (Plenert, 2007). Lean focuses on ‘doing more with less’ (Womack and Jones, 2003). It is multi-dimensional approach comprising a number of best practices like kaizen (Schonberger, 2007), 5S (EPA, 2003), visual controls, just-in-time, total productive maintenance (Shah and Ward, 2003), single minute exchange of dies (Sanjay and Peter, 2006), Poka-yoke (Bhim and Sharma, 2009), kanban and pull production (Shah and Ward, 2003), quality systems, value stream mapping (Bhim and Sharma, 2009), human resource and supplier management (Shah and Ward, 2003) etc., along with a committed role by the leadership (Feld, 2001; Plenert, 2007) and motivated and empowered employees (Wong et al., 2009). However, transforming an enterprise from traditional style of working to lean is not an overnight process. It involves a number of challenges (Norani et al., 2010) including a change in culture of the organization (Hines et al., 2011), strong relationships with the suppliers based on trust and long term commitment and equally strong relations with the customers. In general, the existence of innovative industrial business relations, the establishment or development of logistic and communication networks, the development of appropriate professional training and educational programs are all fundamental for the development of the new “lean” manufacturing system (Panizzolo, 1998).

Some organizations fail to appropriately implement the lean practices resulting in waste of time and resources. The companies face a number of difficulties in implementing lean. They include a lack of direction and planning and a lack of knowledge of adequate project sequencing (Sanjay and Peter, 2006). The barriers in implementing of lean include (Pavanskar et al., 2003; Achanga et al., 2006; Plenert, 2007; Kumar and Naidu, 2012):

- Organizational culture
- Lack of top management commitment
- Attitude of middle management
- Lack of communication
- Employee resistance
- Back sliding to the old ways of working
- Lack of time to implement
- Lack of understanding to implement lean manufacturing concepts
- Budget constraints
- Failure of past lean projects

In Pakistan very little research has been made on lean production. However, some work has been done in neighboring countries. The results of a study in Bangladesh investigated the impact of nine lean production practices on organizational performance. The results showed that lean practices had a significant relationship with desired outcomes like reduction in waste, lead time, and cost of production, and an increase in quality (Farhana, 2009).

3. Methodology

A questionnaire was developed based on extensive literature review. It was sent to the respondent companies by email and, where possible, by personal visits. The follow up process was continued for 7 to 8 weeks. In order to check the internal reliability, Cronbach's alpha was used (Bryman, 2008). Overall reliability of the questionnaire used in this study was 0.82. A group of experts (lean experts, practitioners, textile managers, and academicians) confirmed the face validity of the questionnaire. The experts also showed satisfaction with the construct validity.

Total number of questionnaire sent was 250. Respondents included the executives and the senior managers from quality, lean, and production departments. Properly filled questionnaires returned were 76, giving a response rate of 30.4 %. Multiple responses were collected from the single organization as people have different views and opinions. So, each respondent was considered as individual case. The following research questions were developed:

- RQ1: What are the main drivers, benefits, and tools in implementing lean in Pakistani textile companies?
- RQ2: Is there a relationship between size of company and lean implementation?
- RQ3: Is there a relationship between the type of company and implementation of lean?
- RQ4: Is there any relationship between the age of organization and implementation of lean practices?

RQ5: What is the current lean production status in lean, in-transition, and non-lean textile companies?

RQ6: What are the barriers the companies face while implementing the lean production philosophy?

The companies were divided into four groups based on their age i.e. the number of years since establishment:

- New (less than 10 years)
- Intermediate (10-20 years)
- Intermediate (21-30 years)
- Old (more than 30 years)

The companies were divided into four groups based on their size i.e. the number of employees:

- Small (<500 employees)
- Medium (501-1000 employees)
- Medium (1001-1500 employees)
- Large (>1500 employees)

There were six types of textile units identified:

- Spinning
- Weaving
- Knit wear
- Garments
- Vertical
- Other

4. Data Collection and Analysis

RQ1: What are the main drivers, benefits, and tools in implementing lean in Pakistani textile companies?

The main driver that pushes the company to change to lean system is the organization’s continual improvement program followed by drive to focus on customers and employ world best practices, and to develop key performance indicators. It is interesting to note that increase in market share has not been among the major drivers. The frequency of each driver is shown in Figure 1.

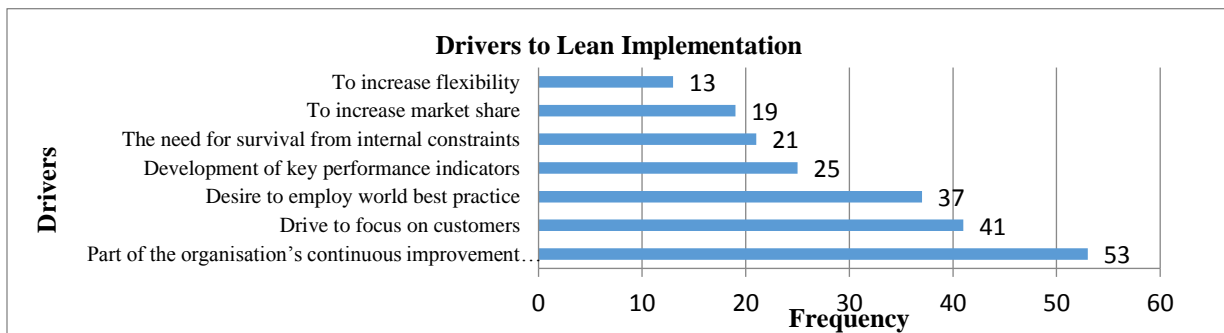


Figure 1. Driving forces to lean implementation

Different companies gain different benefits after practicing lean production techniques. The highest benefit reported by the sample companies was the cost reduction. Cost reduction is crucial for the applicability of lean practices and for the survival of the organizations (Womack et al., 1990; Kumar and Naidu, 2012). Increasing satisfaction of customers was another benefit that the respondents thought could be achieved by implementing lean. It was followed by improvement in delivery time, increase in quality levels, and reduction in waste. The results are shown in Figure 2. Among tools and techniques 5S was used extensively. This is quite evident as 5S is the foundation of all workplace improvement initiatives. It was interesting finding that quality circles are also widely used. This is so because the workers generally have little say in such industries. The results are shown in Figure 3.

Most of the respondents of the respondents were not aware of the term manufacturing planning and control, visual control, kanban, and levelled production. Consequently, these tools, techniques and practices were used the least. Team effort and specialized and cross-functional training were perceived to be crucial to effectively implement lean. Most of the sample companies gave importance to the long term relationship with suppliers and showed commitment

that suppliers consistently deliver quality. Similarly, customer satisfaction and on-time delivery to the customer was considered crucial.

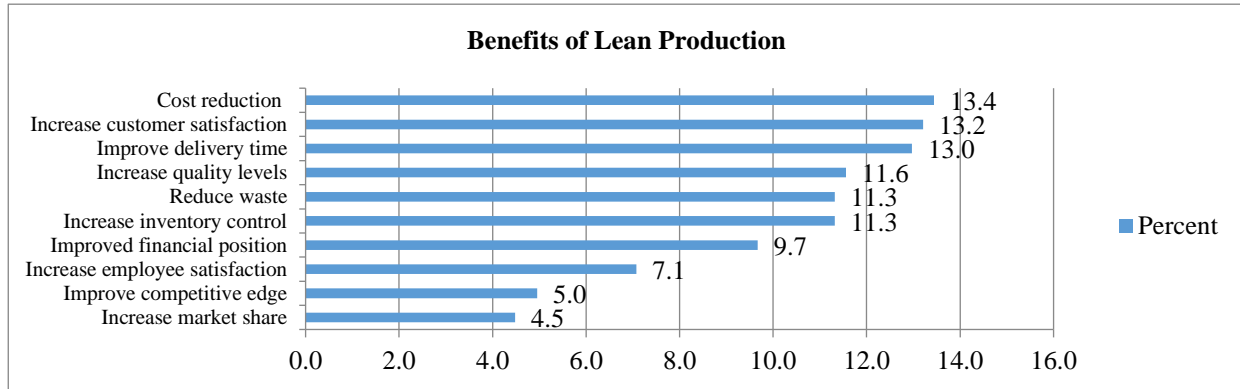


Figure 2. Benefits of lean manufacturing

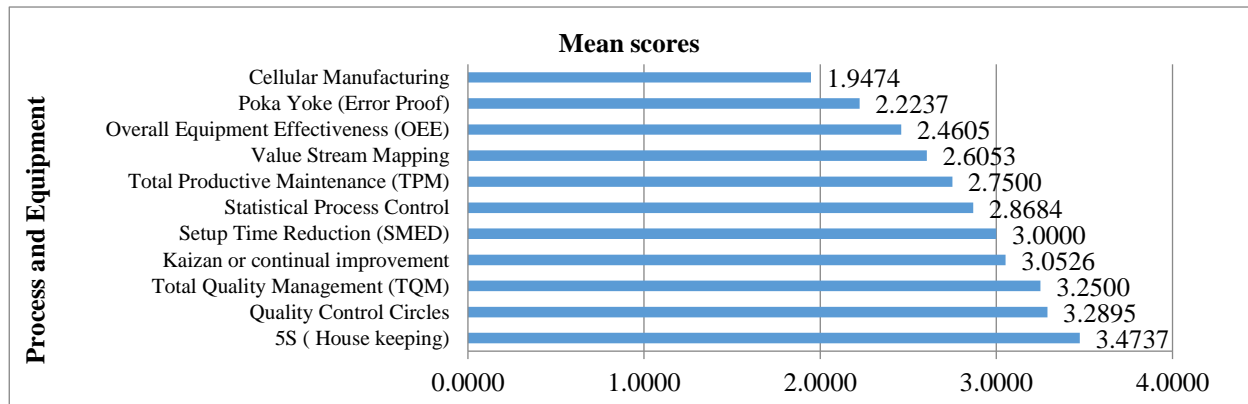


Figure 3. The adoption of process and equipment related practices

RQ2: Is there a relationship between size of company and lean implementation?

The level of implementation was categorized into three groups: good, fair, and poor. From Table 1 it is concluded that the larger organizations used more lean manufacturing practices than smaller or medium sized organizations. As the number of employees increases, the percentage of lean manufacturing practices also increases. In larger firms, 22.2% firms have poor implementation of lean practices while 80.0 % firms have fair implementation and 83.8% firms showing good implementation level of lean manufacturing practices. It is also shown that 33.3% and 44.4% medium sized firms having poor implementation of lean production practices while the 6.7% and 6.7% have fair level of implementation and 2.7% and 5.4 % medium sized firms shows good level of lean manufacturing practices implementation. While 0.0% small firms have poor implementation, 6.7 % fair implementation, and 8.1% have good application of lean implementation.

From the endnote of the Table 2, it is concluded that 75 % cells have expected count less than 5. There is a significant relationship between the implementation of lean manufacturing and the size of the company ($\chi^2 = 24.428$, $p = 0.000$, $df = 6$).

RQ3: Is there a relationship between the type of company and implementation of lean?

Table 3 shows that the difference in implementation of lean manufacturing practices is statistically significant among different types of companies ($\chi^2 = 22.483$, $p = 0.013$, $df = 10$) i.e. there is a relationship between the implementation of lean manufacturing practices and type of textile company.

Table 1. The relationship between the size of the company and lean manufacturing implementation

			Number of employees				Total	
			<500	501-1000	1001-1500	>1500		
Lean Manufacturing Implementation	Poor Implementation	Count	0	3	4	2	9	
		% within Lean Production Implementation	0.0%	33.3%	44.4%	22.2%	100.0%	
		% within Number of employees	0.0%	50.0%	50.0%	3.5%	11.8%	
		% of Total	0.0%	3.9%	5.3%	2.6%	11.8%	
	Fair Implementation	Count	2	2	2	24	30	
		% within Lean Production Implementation	6.7%	6.7%	6.7%	80.0%	100.0%	
		% within Number of employees	40.0%	33.3%	25.0%	42.1%	39.5%	
		% of Total	2.6%	2.6%	2.6%	31.6%	39.5%	
	Good Implementation	Count	3	1	2	31	37	
		% within Lean Production Implementation	8.1%	2.7%	5.4%	83.8%	100.0%	
		% within Number of employees	60.0%	16.7%	25.0%	54.4%	48.7%	
		% of Total	3.9%	1.3%	2.6%	40.8%	48.7%	
	Total		Count	5	6	8	57	76
			% within Lean Production Implementation	6.6%	7.9%	10.5%	75.0%	100.0%
% within Number of employees			100.0%	100.0%	100.0%	100.0%	100.0%	
% of Total			6.6%	7.9%	10.5%	75.0%	100.0%	

Table 2. The relationship between the company size and lean manufacturing implementation

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	24.428a	6	.000
Likelihood Ratio	19.258	6	.004
Linear-by-Linear Association	3.380	1	.066
N of Valid Cases	76		

a. 9 cells (75.0%) have expected count less than 5. The minimum expected count is .59.

Table 3. The relationship between lean production practices and the types of company

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	22.483a	10	.013
Likelihood Ratio	26.152	10	.004
Linear-by-Linear Association	.425	1	.515
N of Valid Cases	76		

a. 12 cells (66.7%) have expected count less than 5. The minimum expected count is .36.

RQ4: Is there any relationship between the age of organization and implementation of lean practices?

On the basis of the literature review, it is concluded that age and lean implementation are negatively correlated i.e. older the organization lesser the lean implementation because it is difficult for the organization to change production system and organizational culture. However, this study did not yield a significant relationship between these two factors. Table 4 shows that the value of the Pearson Chi-Square is 7.677 at significance level of 0.263, indicating that the results are not significant. There is no relationship between the age of the company and the implementation of lean manufacturing.

Table 4. The relationship between the size of the company and lean manufacturing implementation

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.677a	6	.263
Likelihood Ratio	8.083	6	.232
Linear-by-Linear Association	1.494	1	.222
N of Valid Cases	76		

a. 6 cells (50.0%) have expected count less than 5. The minimum expected count is .59.

RQ5: What is the current lean manufacturing system status in lean, in-transition, and non-lean textile companies?

In order to identify the lean manufacturing status cluster analysis was used. Objects (or cases, observations, companies, people, things) in a specific cluster share many characteristics while are very dissimilar to objects not belonging to that cluster (maximizing the dissimilarity between groups that are initially unknown).

Clustering variables were categorized into five: Process and equipment, manufacturing planning and control, human resources, supplier relationships, and customer relationships. The analysis is performed based on the average values of variables for all the respondents and indicates the extent of implementation of the lean manufacturing according to their lean status. The same method was used by Panizzolo (1998) in his research to identify the factors that differentiate the firms. Shah and Ward (2003) and Norani, et al. (2010) also used it in their work.

Using a hierarchical cluster analysis, three clusters were identified. These three cluster groups are named as lean, in-transition (towards lean), and non-lean according to their mean values. First, lean group (A) has 22 companies and is categorized as lean group because these companies are having highest mean score of all the lean manufacturing tools, techniques, and practices used in this survey. The second group (B) is in-transition, having 43 companies and these companies have the moderate mean scores of the all variables. Finally, the non-lean group (C), which has 11 companies, is classified as non-lean because of low mean scores of all variables.

It is concluded that all groups (A, B, C) are focusing on building suppliers and customers relationships. Group (A) i.e. lean firms are emphasizing on human resource and spend resources on process and equipment while little focus is given to manufacturing planning and control. Group (B) is on moderate level of implementation and focuses on human resource while group (C) just concentrates on building good relations with supplier and with customers. So the least implemented lean manufacturing practices in all groups is manufacturing planning and control.

Table 5 shows that lean cluster (A) has shown higher mean scores in all lean production practices than the other two groups and non-lean cluster (C) has the lowest mean scores. As a result, these findings are consistent with the known theory that lean cluster have significantly higher mean practices.

Table 5. Mean values for three clusters

	Lean (A) n=22 (28.9 %)	In-transition (B) n=43 (56.6%)	Non Lean (C) n=11 (14.5%)
Process and equipment	3.2934	2.8647	1.6364
Manufacturing process and control	2.8977	2.3721	1.4318
Human resources	3.6667	3.1059	1.8081
Supplier relationship	3.1023	3.4244	3.0227
Customer relationship	4.0303	3.8605	3.3333

n = number of companies

% = percentage of companies

In order to check the statistical significance of the difference in five variables across the three cluster groups, ANOVA test was conducted.

In order to examine whether the cluster means are the same, they can be represented by the F-ratio for the combined effect between-group. Table 6 shows the results of ANOVA. It shows significant effect of clustering variables on the cluster groups except for suppliers and customers relationship.

Table 6. ANOVA results for testing significance between cluster means

		Sum of Squares	df	Mean Square	F	Sig.
Process & Equipment	Between Groups	20.421	2	10.210	27.062	.000
	Within Groups	27.542	73	.377		
	Total	47.963	75			
Manufacturing Planning and control	Between Groups	15.784	2	7.892	12.386	.000
	Within Groups	46.515	73	.637		
	Total	62.299	75			
Human Resource	Between Groups	25.396	2	12.698	24.747	.000
	Within Groups	37.458	73	.513		
	Total	62.854	75			
Suppliers Relationship	Between Groups	2.316	2	1.158	2.009	.141
	Within Groups	42.081	73	.576		
	Total	44.397	75			
Customer Relationship	Between Groups	3.635	2	1.818	2.762	.070
	Within Groups	48.031	73	.658		
	Total	51.667	75			

RQ6: What are the major barriers faced by the textile companies while implementing the lean manufacturing philosophy?

Based on the literature review, ten factors that resist implementation were identified and included in the questionnaire. Frequency table and charts were used to analyze the data. From Table 7, it is indicated that in non-lean firms, the four main barriers are: the employee resistance, lack of communication, company culture, and lack of understanding. On the other hand, the firms which are in transition towards lean manufacturing system the company culture, employee resistance, lack of communication and the lack of understanding to implement lean manufacturing are major factors. Again for the lean firms, lack of communication is the main barrier in implementing lean manufacturing system successfully. The results are also shown in Figure 4.

Table 7. Barriers faced by Pakistani textile companies in the implementation of lean manufacturing

Sr. No.	Lean barriers	Mean Score			
		In Transition	Lean	Non Lean	Total
1	Company Culture	3.3256	2.0909	3.9091	3.0526
2	Lack of top management commitment	2.3256	2.3256	2.9091	2.3026
3	Attitude of middle Management	2.7209	2.7273	2.8182	2.7368
4	Lack of communication	3.0233	3.3636	4.0000	3.2237
5	Employee resistance	3.3023	2.6364	4.0909	3.2237
6	Back sliding to the old ways of working	2.3023	1.8636	3.3636	2.3289
7	Lack of time to Implement	2.7674	2.2727	3.6364	2.7500
8	Lack of understanding to implement lean manufacturing concepts	2.9535	2.1364	3.9091	2.8553
9	Budgets constraints	2.2093	2.3182	3.5455	2.4342
10	Failure of past lean project gets constraints	1.6279	1.1818	1.6364	1.5000

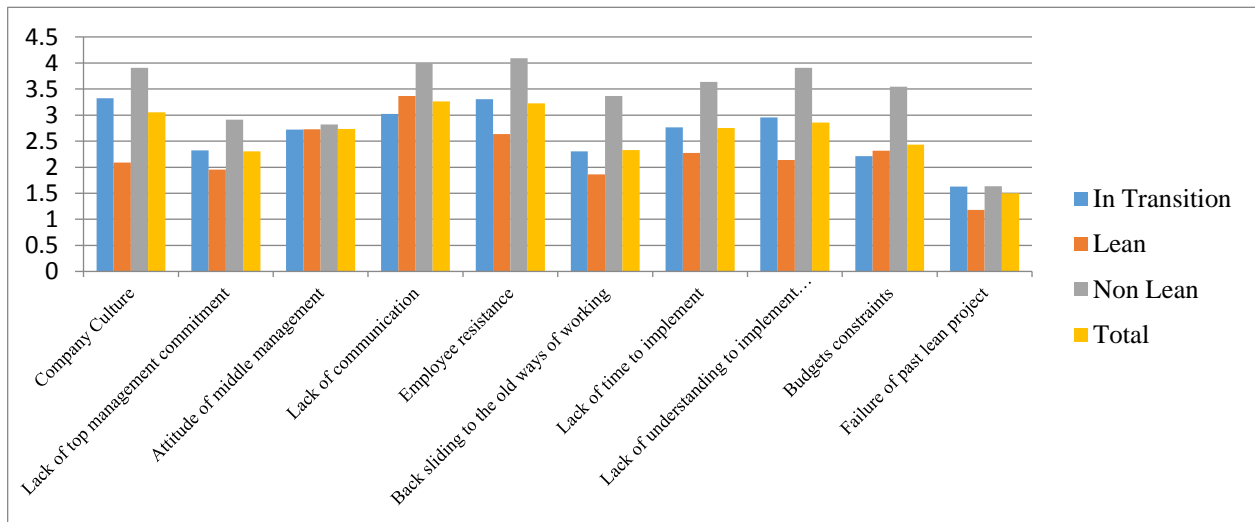


Figure 4. Barriers faced by Pakistani textile companies in the implementation of lean manufacturing

5. Discussion

The findings of the study show that the lean manufacturing is not implemented effectively in textile companies of Pakistan. This sector lacks understanding of lean manufacturing concepts and therefore has not reaped the full benefits of lean implementation. Most companies only focus on a few tools and techniques neglecting others. For example, 5S (housekeeping) is extensively used while manufacturing planning and control is used rarely. Industries have not employed a systematic approach in lean implementation.

The textile companies in Pakistan need a focused training on lean manufacturing to enable its better understanding. They need to invest in training of employees and make sure employees are involved in the whole process. As

employees show resistance to change so attention should be given to change their mind set. Incentives should be given to the workers for their support. The benefits of lean must be shared among all stakeholders.

It is recommended for future research to concentrate on single unit (spinning, weaving, knit wearing, and garment) of textile rather than overall sector. This will provide better understanding of lean performance in a specific type of unit.

The companies should be encouraged to benchmark their system with the world class firms. This can help bring rapid improvements in their performance. Gap analysis should be performed between Pakistan and other countries that are having well established lean system.

As the data were collected through questionnaire and were based on the perception of the respondents. This was not supported by any secondary data from any other organizational source and no instrument was available to gauge the exact situation that exists in sample companies. Therefore, future research should be based on detailed investigation through interviews, documents review, observations, and qualitative approaches to generalize the results of this study.

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Biography

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