



An Investigation of Manufacturing Performance Improvement through Lean Production: A Study on Bangladeshi Garment Firms

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Abstract

The benefits of lean manufacturing are evident in factories across the world. With a view to achieve performance improvement both the developed and developing countries are practicing lean. In this study nine garment manufacturing companies were selected as sample. A field survey with a semi-structured questionnaire, interviews and site visits were conducted to get necessary lean information from the respondent. These companies were selected purposively to ensure the best possible scenario of lean practices in Bangladesh.

The focus of this study is to investigate the improvement of manufacturing performance through lean practice in the Bangladeshi garment industry. The findings indicate that the selected companies have adopted a wide variety of lean tools and techniques and gained many performance improvements. Findings also identified the business challenges that drive the companies to practice lean as well as the areas where changes have been made. It concludes with suggestions for further work.

Keywords: Lean production, Bangladesh, Ready made garments, Manufacturing performance, Improvement

1. Introduction

"Manufacturers are now a days facing intensive global competition. They are becoming increasingly aware of the importance of modern management philosophy in providing them with a competitive advantage in a free market system" (Yeung and Chan, 1999, p.756). As stated by Mannan and Ferdousi (2007, p.2) "Now the key to competing in the international market place is to simultaneously improve both quality and productivity on continual basis". In today's competitive and changing business world, lean production philosophy has brought changes in management practices to improve customer satisfaction as well as organizational effectiveness and efficiency (Karim, 2008). Firms are now more concerned about customer satisfaction because they have now more options than before. Customers are now demanding a wide variety of products at a lower cost but with fast delivery. They also expect more innovative products at a competitive price (SAP AG, 2005) as customers have more opportunities to choose from a variety of options.

The major purposes of the use of lean production are to increase productivity, improve product quality and manufacturing cycle time, reduce inventory, reduce lead time and eliminate manufacturing waste. To achieve these, the lean production philosophy uses several concepts such as one-piece flow, kaizen, cellular manufacturing, synchronous manufacturing, inventory management, pokayoke, standardized work, work place organization, and scrap reduction to reduce manufacturing waste (Russell and Taylor, 1999). In lean production systems attempts are made to eliminate waste through continuous improvement of processes of the entire value chain in the organization. Having nurtured a lean manufacturing mindset among the employees, it facilitates achievement of continuous product flow through physical rearrangement and control mechanisms. A study (Sohal, 1996, p.91) indicates that *"most western*

manufacturers have been aware of the need to improve their performance and competitiveness for nearly two decades". They were using lean production system for taking advantage of most of the above benefits. Another study (EPA, 2003) summarized the main reasons for adopting a lean system under three broad categories: reducing production resource requirements and costs, increasing customer responsiveness, and improving product quality. It concluded that all of these combine to boost company profits and competitiveness.

As stated by Papadopoulou and Ozbayrak, (2005) that this concept spread to Japanese factories after it was first implemented in the Toyota Motor Company. When another developed and developing countries are reaping several benefits from the practice of lean, in Bangladesh its adoption is very slow. Anecdotal evidence indicates that the few organizations that have adopted lean practices have experienced an overall improvement in corporate performance (Mamun and Afrin, 2001). While some work (Harun, 1990) has been done regarding the theoretical aspect of JIT; a little work has been done in the area of lean practices in the Bangladeshi enterprises.

In the face of fierce competition resulting from the rapid globalization of businesses in Bangladesh, some companies across the garment industry sector have been practicing lean production to remain globally competitive and create a strong market position. There is a lack of research evidence regarding the impact of lean practices on manufacturing performance improvement in Bangladeshi garment firms. Researchers are mostly silent on this very important area of production philosophy. The entire field of lean remains unexplored in Bangladesh. This research attempts to bridge this gap. Due to political turbulence, undeveloped economic infrastructure, high traffic problem, there is a strong belief that maintaining a strong supplier partnership is difficult. This requires a careful and systematic investigation. The present study deals with the emerging issues and investigates the lean practices in the Bangladeshi firms and their impact on manufacturing performance improvement.

2. Literature Review

"Businesses all over the world are now facing fierce competition because of liberalization of trade and globalization. Foreign competition has penetrated into almost all the industries, both in the production and service sectors. There prevails a view that organizations in Europe, Japan and the several developing countries are seizing the initiative in a dozen key technologies, including factory, automation, consumer electronics, microchips and aerospace. Many countries are emerging as strong competitors and challenges for those who have already been industrially developed" (Mannan and Ferdousi, 2007, p.4).

"Lean Production" was introduced by a book titled *The Machine That Changed The World* written by **Womack et al.**, (Piciacchia, 2003). *"The idea of lean thinking comprises complex cocktail of ideas including continuous improvements, flattened organization structures, team work, elimination of waste, efficient use of resources and cooperative supply chain management"* (Green, 2000, p.524). This is a Japanese concept applied in manufacturing firms. The Japanese firms (firms in other countries as well) have been using this concept to reduce the cost of any process (be it service or manufacturing) by removing waste. The basic elements of the concept include waste elimination, continuous one piece workflow (EPA, 2003). As stated by Kilpatrick (2003), lean makes an organization more responsive to market trends, deliver products and services faster and produces products and services less expensively than non-lean organization. As viewed by Womack and Jones (1994), firms in several industries in North America, Europe and Japan followed this path and doubled their performance through reduction of inventories, throughout times and errors.

According to Alukal and Manons (2002), a planned implementation of lean production system leads to improved quality, better cash flow, increased sales, better productivity, improved morale and higher profits. They further reported that companies earned greater benefits by implementing lean techniques in the office functions in non-manufacturing organizations too, such as banks, hospitals, restaurants etc. A study on a Novartis International AG - A Switzerland-based company (Society of Manufacturing Engineers, 2002) reviewed their production process and realized the need for some improvement. They introduced lean picking system for the movement of the goods from the warehouse to the packing lines. This redesigned material supply is a kind of Kanban system. Through this picking system the company reduced its waste to a good extent. By using this system they were benefited in terms of waste elimination from the redesigned material supply process. The study was anticipated that this lean picking system would facilitate faster picking lines as well as would shorter the run times.

There are studies have been undertaken bearing upon the relationship between lean practices and manufacturing performance of the firms (Papadopoulou and Ozbayrak, 2005; Bonavia, 2006; Simpson et al., 1998, EPA, 2003; Oliver et al., 1993) and also have showed the improvement in manufacturing through lean practice. Chihuahua (Society of Manufacturing Engineers, 2007), the producer of world class power and signal distribution system of Mexico, reviewed its existing manufacturing system and identified the need for improvements. The company introduced lean with a view to improve the current performance. It is documented from the study that implementation of lean brought 34% reduction in inventory over a 12 months period and 93.5% uptime. The study showed that the keys to achieving quality in manufacturing include the flexibility of the production system, and involvement and commitment of employees.

As stated by Narain and Yadav (2004), “*Since the advent of economic liberalization in the early nineties the manufacturing scene in India has witnessed major upheavals. Reeling under the heavy burden of stiff international competition, Indian manufacturers throughout the country has now begun to place greater reliance on their own strengths to harness the latest technologies available, and to pursue the best management practices followed elsewhere in the world in an attempt to become lean and agile*”. The several sectors of India were and are still facing relentless pressure on prices as a result of heightened competition. In this crisis situation Indian firms have achieved positive results through lean manufacturing. In India, three case studies indicate that lean manufacturing practices helped the companies (in the engineering products industry) achieve improvements to a significant extent, in such areas as turnover (36%-50%), production setup time (74%), machine down time (60%-100%), production space (17%-45%), delivery against schedule (21%), product rejection by customers (50%), productivity awareness (increased dramatically), quality awareness increased steadily, scrap reduction (75%), increase of workforce flexibility (57%-100%), and staff motivation improved significantly (1000-Venture, 2007). Another case study was conducted by Simpson et al. (1998) on a Malaysian automobile company, Proton, to develop an understanding of a Malaysian version of JIT. Proton is the largest and modern automobile manufacturer of South East Asia. The company use robots and automation in production processes. It introduced *Kanban* - various types of containers for holding components or movement of components. It also introduced several supporting mechanisms to complement the use of JIT system and organized training program for the employees. All these reduced work in progress from three months to one month of supply, 50% of space required and brought improvement in inventory turns from 15 to 31. Although several constraints had been faced, the study showed the success of the company with many benefits.

The pressure placed on firms in the garment industry from international competition and dynamic changes in the retail sector have been enormous. “*The increase in competition has led to an increased focus on customer satisfaction as a survival of the company in the long run*” (Kapuge and Smith, 2007, p.304). In today’s competitive business world, firms are fighting against each other just to ensure their survival. In this highly competitive business market, the garment industry is also searching for ways and techniques to cut cost and improve performance. When other industries are facing high pressure from competitors, the garment industry is also facing challenges such as- price, delivery time and service offered etc. This industry has opportunities to improve, but requires some changes. Under the highly competitive environment, the garment industry has numerous opportunities for improvement using lean principles (Mercado, 2007).

Through the implementation of lean the garment sector can reduce costs, as well as increase customer responsiveness through reducing several types of waste from the production process. Customers demand quality products and on-time delivery. Lean practices can fulfill these requirements by reducing lead-time as well as manufacturing cycle time. Now, many countries have started to practice lean tools in the garment industry and observed tremendous improvement (Mazany, 1995; Bruce et.al; 2004). This practice has improved their productivity, quality and lead-time and also made their customer more responsive. In addition to this lean production involves, motivates and develop employee skills through education and multi-skilling program (Mazany, 1995).

3. Objectives and Research Methods

The general objective of the paper is to examine the manufacturing performance improvement through lean production practices in the selected Bangladeshi firms. The specific objectives include:

- i. Examining the manufacturing performance improvement experienced by the selected garment firms to implement lean.
- ii. Identifying the business challenges faced by the selected garment firms to practice lean.
- iii. Identifying the areas where changes have been made to implement lean in the selected Bangladeshi firms.

This paper is primarily based on the data collected from the field survey in nine garment companies (out of 45 companies) from EPZ (Export Processing Zone) in Bangladesh, using a semi-structured questionnaire. Interviews with ‘lean implementers’ and plant observation was also conducted by the researcher. These nine companies were purposively selected because of the limited use of lean as well as to ensure the best possible scenario of lean implementation.

4. Result and Findings

A total of nine organizations (garment firms) were selected for the purpose of this study. An analysis of the organizational issues helps to appreciate the nature of the organizations. It appears that legal status of the companies has little influence over legal practices. Result showed that nearly half of the companies are international joint ventures and one third of them were public limited and the rest were private limited companies (Table A1). The companies are of the view that the registration of a company under the government is a prerequisite for obtaining legal entity.

The study results revealed (Table A2) that some companies initiated lean implementation from the beginning of the

commencement of production in their plants, while others started lean implementation after a few years from the year of establishment. However, the findings suggest that since all companies have been successful in reducing cost and improving productivity, it is not the length of time of practices, but rather the effectiveness of implementation that determines the success of lean implementation. Team work is one of the core concepts of lean production. Findings revealed that 56% of the companies had team based structures and the remaining companies had functional structures. This is in sharp contrast with the general notion that a team structure is essential for lean implementation, or the successful implementation of any kind of change initiative. Although it is revealed in the sample that variation among the firms with different organizational structure is not an obstacle in lean implementation, at the same time it is indicated that top management of the companies are not aware of the fact that a functional structure restricts flexibility.

Table A3 indicate that the majority of the companies were dependent on a large supplier base which is in contrast to the lean practice fundamentals. Although all of the companies intend to maintain long-term relationships with suppliers (Table A4), maintaining long and stable relationships with such a large supplier base is, in reality, difficult.

The findings indicated the sample companies had adopted a large variety of lean tools and techniques such as Kanban (66%), JIT (100%), 5S (44%), Pull production (100%), TPM (89%), Kaizen (78%) etc (Table A5). To practice the above mentioned lean tools the selected garment firms experienced several improvements in manufacturing performance.

4.1 Manufacturing Performance Improvement through Lean Practice

4.1.1 Savings Resulting from Lean Practices

It is a usual expectation that lean practices would result in considerable savings. An attempt was made to elicit information regarding the amount of savings that the companies could achieve during the one year. The respondents in all companies did not agree to provide actual data regarding amount of savings. However, an analysis of the views of the respondents suggests that 44% of the sample companies made significant savings over 12 months period through the reduction of labor costs in the production process (Table A6). As reported by the senior managers, the companies could reduce labor costs through reduction of the number of workers. The workers handled a larger variety of works and this resulted in good savings. Over a long period of time the accumulated savings would be very significant.

4.1.2 Reduction in Production Costs

An attempt was made to get the opinion of the plant managers regarding the reduction of production costs due to implementation of lean system. The respondents provided data concerning the unit costs of production before lean and after lean. The results are presented in Table A12.

The data indicates that the maximum per unit cost reduction was \$2.00 and minimum was \$0.03. For five companies, the improvement in cost was fairly substantial while for others the improvement was negligible (3.44% to 14.28%). Whatever cost reduction occurred, it was achieved through an increase in the number of units of products with the same workers as well as reduction in the inventory compared with the pre-lean period.

4.1.3 Total Productivity Improvement

In response to a question - "What is the average productivity increase in the company after implementation of lean?"- the sample companies indicated that their productivity improved by a maximum of 60% and minimum of 10%. The majority (67%) of the companies had 10% to 20% productivity improvement whereas the remaining had 40% to 60% improvement (Table A7).

No actual data on productivity could be obtained from the companies, as the companies consider these data strictly confidential. Thus, no generalization is possible about productivity based on the opinion of the respondents.

4.1.4 Lead Time

Data were collected on the total amount of time taken to complete an order from the procurement of raw materials to final manufacturing of a product. The time taken is expressed in terms of the average number of days, known as lead time. The shorter the lead time, the more gain for a company and better the satisfaction of customers. The collected data are tabulated in Table A13.

An analysis of the tabulated data shows that the lead time in the companies ranged from 16 days to 120 days before implementation of the lean production system, while the corresponding lead time reduced within the range of 13 days to 105 days—the minimum reduction being three days and maximum 30 days. The data also indicate that three companies saved 8% -12.5% , two companies saved 18%-25% and four companies saved from 33%-50%. Through implementing lean, the companies focused on JIT delivery of raw materials, proper equipment layout etc. which ultimately reduced the overall lead time to complete an order.

4.1.5 Quality Improvement

In response to a question—"What is the average quality improvements in the company due to lean implementation?"- the

surveyed companies reported that their quality improved to a maximum of 80% and minimum of 10%. While 33% of the companies had 10% to 20% quality improvement, similar proportion of the companies achieved quality improvement ranging from 41% to 60% (Table A8).

About one-fifth of the companies had 21% to 40% improvement in quality while only one company showed 61% to 80% improvements. From the discussion it is revealed that this was achieved by following the buyers' prescribed quality system as well as quality control process.

4.1.6 Manufacturing Cycle Time

In a lean production system, continuous endeavors need to be made for the reduction of manufacturing cycle time. The higher the improvement in cycle time (i.e., reduction in the time taken), the greater is the gain to the company in terms of lead time as well as timely delivery of products. Because the company can make more product in a given time and can make fast delivery. In the present study, the companies experienced some gains in terms of reduction in manufacturing cycle time that ranged from 5 minutes to 20 minutes (Table A14), thereby indicating a time-savings of 12.5% to 33.33%.

It is worth-mentioning that in a garment factory the sequence of work for making a product is fixed up in terms of minutes. This is because many products require less than an hour of time from the beginning to the end of the cycle.

4.2 Business Challenges Faced by the Companies to Practice Lean

Table A9 shows the response to the question: "What business challenges have driven the company to practice lean?" The majority (56%) of the companies showed high competition as a major challenge to practice lean followed by the pressure from customer-company (22%), cost reduction (22%), reduced order or losing market demand (22%). In addition to these business challenges, the reasons to change to lean production techniques arose from a number of different sources in a few companies, such as (Table A10):

- Desire to minimize costs by reducing inventory
- Intention to satisfy customers
- Encouragement of foreign buyers to introduce lean for cutting costs of production
- motivation from promoters/employees
- improving the current condition
- searching for best practices

The reasons toward lean production practice were not common for all companies, except a few. The above changes occurred for various reasons. Customer satisfaction is at the centre of all production functions. And customers cannot be satisfied unless they can be given products with the right quality with the competitive prices. So, the desire to maximize customer satisfaction led the firms to implement lean practices. The buyers abroad as well as the owners also encouraged the management of the companies to move from traditional production system to more improved system for reducing costs that would eventually reduce prices of products. Management people also intended to improve the current, traditional system of production in order to be more competitive in the market. One company also learned about the lean system while they searched for best practices in other competitive companies.

4.3 Areas Where Changes Have Been Made

Majority (78%) of the companies said that changes in product design and manufacturing process occurred in their organization as a result of lean implementation; 44% respondents indicated a change in supplier networks and the remaining (22%) focused on factory management followed by inbound logistics (11%) and outbound logistics (11%) (Table: A15).

In addition, companies mentioned a variety of changes that took place within their organizations (Table A 11). These include:

- cultural change
- education of workers and suppliers
- empowerment of employees
- commitment of top level managers
- relationship with suppliers
- rearranging the manufacturing process
- creating awareness

Managers need to address required changes for lean implementation. In this study different companies have indicated and experienced different changes such as cultural change, education of workers and suppliers, empowerment of employees, commitment of top level managers, relationship with suppliers, rearranging the manufacturing process and creating awareness.

5. Conclusion

Lean production reduces all forms of non-value added activities in organizations and improves its performance. From the analysis of the data collected, it appears that companies that adopt lean manufacturing as a working philosophy within their organizations can make significant improvement in terms of their operational performance even if it is in a modified format that best suits their particular business culture. It is obvious that there are strong benefits to be gained from implementing a lean manufacturing culture, as demonstrated by the companies in this study.

In order to obtain information about the improvement in manufacturing performance through lean production practices in the selected Bangladeshi garment firms, the study examined the adoption of various lean tools. In addition to this the study also identified the business challenges faced by the companies to practice lean as well as the areas where changes have been made to implement lean successfully.

6. Recommendations for Future Research

The study results indicate some recommendations for further work. This is the first pilot study in this area with a small sample size and therefore a follow up study is needed. It would be more illuminating to conduct a longitudinal study to understand the long-term effects and benefits of lean in the Bangladeshi garment industry. In addition to this, relationship with local suppliers and how to build strong and long-term relationship should be studied further. A meaningful recommendation that can be put forward for the Bangladesh Government is that it can work for creating a level playing field for the garment manufacturing firms, in particular, to practice lean production systems mainly through making arrangement for relevant training programs and development of necessary physical infrastructures.

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APPENDIX-1: STATISTICAL TABLES (based on the questionnaire and Interview)

Table A1. Legal Status of Companies

	Legal status	Percentage
(a)	Public Limited Company	22
(b)	Private Limited Company	33
(c)	International joint venture company	45
	Total	100

Table A2. Year of starting lean based on the year of establishment of the companies

Year	No. of companies	Percentage
1 st Year	3	55
4 th Year	1	11
6 th Year	1	11
9 th Year	1	11
11 th Year	1	11
	Organizational Structure	
	Nature of structure	Percentage
(a)	Tall functional structure (long hierarchy)	44
(b)	Flat structure (team based)	56
(c)		
	Total	100

Table A3. Number of local and foreign suppliers of raw materials

	Number of suppliers	Percentage
(a)	1-10	33
(b)	11-50	45
(c)	>50	22
	Total	100

Table A4. Supply related information

	Particulars of supply	Percentage
a)	Company intends to maintain long stable relationship with suppliers	100
b)	The main suppliers are in close proximity	44
c)	The company has reduced the number of suppliers over the last five years	22
d)	Suppliers are dependable in terms of timely delivery	100

Table A5. The different lean techniques the companies have adopted (Multiple responses)

	Lean techniques	Percentage
(a)	Kanban	66
(b)	Daily schedule adherence	100
(c)	Small lot size	100
(d)	Just-in-Time	100
(e)	Physical arrangement of equipment	89
(f)	Application of preventive maintenance	89
(g)	Pull production systems	100
(h)	Continuous improvement	78
(i)	5S	44
(j)	Other quality practices (QC)	100

Table A6. Savings resulting from lean practices

	Nature of savings	Percentage
a)	Savings of the company over 12 months period	44
b)	No savings over 12 months period	56

Table A7. Productivity increase resulting from lean practices

	Average productivity increase after implementation of lean	Percentage
	10%-20%	67%
	40%- 60%	33%

Table A8. Quality improvements resulting from lean practices

	Views about quality increase	Responses (%)
	The average (%) quality increase in the company after lean implementation	
	(a) 10%-20%	
	(b) 21%-40%	33
	(c) 41%-60%	22
	(d) 61%-80%	33
		11

Table A9. Business challenges those have driven the companies to practice lean

	Types of challenges	Percentage
	Pressure from customer company	22
	To beat the competitors	56
	Cost reduction	22
	Reduced order/ losing market demand	22

Table A10. Reasons towards lean production practice

	Element	Percentage
	Customer satisfaction	11
	Minimization of cost by reducing inventory	22
	Motivation from buyers	11
	Motivation from customers	11
	Motivation from promoters/employees	11
	High Competition	22
	To improve the current condition	11
	Searching for best practices	11

Table A11. The changes required to be addressed while implementing lean those have been experienced by the companies

	Required changes to be addressed	Percentage
	Cultural change	22
	Education of workers and suppliers	22
	Empowerment of employees	1
	Commitment of top level managers	1
	Relationship with suppliers	1
	Rearranging the manufacturing process	1
	Changes in the traditional work environment	1
	Creating awareness	1

Table A12. Reduction in unit production cost

Company	Before Lean (\$)	After Lean (\$)	Reduction (\$)	As a %
1. Fashion Point Ltd.	8.50	7.00	1.50	17.6
2. Texas Fashion Ltd.	11.0	9.00	2.00	18.1
3. Beximco Fashions Ltd.	4.40	3.20	1.20	27.2
4. Shanta Industries Ltd.	10.0	8.00	2.00	20.0
5. DADA(Savar) Ltd.	1.40	1.30	0.10	7.1
6. Shata WashWorks Ltd.	3.50	3.00	0.50	14.2
7. Armana Fashions Ltd.	0.87	0.84	0.03	3.4
8. Shanta Denims Ltd.	-	-	-	-
9. PAXAR Bangladesh Ltd.	4.50	3.00	1.50	33.3

Table A13. Total amount of time (average number of days) taken to complete an order from raw materials to manufacturing

Company	Before Lean	After Lean	% gain due to Reduction
1. Fashion Point Ltd.	30	15	50
2. Texas Fashion Ltd.	16	13	19
3. Beximco Fashions Ltd.	80	70	13
4. Shanta Industries Ltd.	120	90	25
5. DADA(Savar) Ltd.	40	25	38
6. Shata WashWorks Ltd.	42	28	33
7. Armana Fashions Ltd.	60	55	08
8. Shanta Denims Ltd.	120	105	13
9. PAXAR Bangladesh Ltd.	60-90	40-45	33-50

Table A14. The amount of time (hour/minutes) to accomplish standard work sequence for making a product

Company	Before Lean (minutes)	After Lean (minutes)	Reduction (minutes)	% of reduction
1. Fashion Point Ltd.	60	40	20	33
2. Texas Fashion Ltd.	30	15	15	50
3. Beximco Fashions Ltd.	55	49	06	11
4. Shanta Industries Ltd.	75	60	15	20
5. DADA(Savar) Ltd.	50	39	11	22
6. Shata WashWorks Ltd.	60	40	20	33
7. Armana Fashions Ltd.	50	40	10	20
8. Shanta Denims Ltd.	60	40	20	33
9. PAXAR Bangladesh Ltd.	40	35	05	13

Note: The percentages have been rounded to nearest figure.

Table A15. Areas of organization where changes were made

#	Areas of changes	Percentages
1	Product design	78
2	Inbound logistics	11
3	Outbound logistics	11
4	Manufacturing Processes	78
5	Supplier network	44
6	Factory management	22