Factors Affecting Successful Implementation of Lean Manufacturing Tools and Techniques in the Apparel industry in Sri Lanka

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Abstract— **Lean Manufacturing is a business strategy which was originated and developed in Toyota Motor Company, Japan. It is useful in identifying waste associated with processes. As a result companies can improve their productivity and quality and can achieve a competitive advantage over others. Lean Manufacturing was originated in automotive industry and then later on spread to many other industries in both developed and developing countries. In implementing this concept Toyota has introduced and developed many tools and techniques which can be used effectively.**

In Sri Lanka, apparel sector is the leader in implementing Lean Manufacturing. However a little research work is carried out in regarding its suitability. Therefore in order to fill this empirical gap, this research is an attempt to identify factors such as suitable methods of implementation, order of implementation, challenges, how to overcome those challenges and benefits of implementing Lean Manufacturing concepts in the apparel sector of Sri Lanka.

The study first undertook literature review in the field of Lean Manufacturing. Then it developed broader research questions and administered them to fifteen apparel manufacturers in Sri Lanka using personal interviews and observations methods. The sample firms were selected judgmentally. In analyzing the data descriptive statistics and qualitative techniques were used.

The result of the study revealed factors such as implementation strategies, order of implementation, challenges, how to overcome those challenges and benefits have influenced the successful implementation of Lean Manufacturing in mass production apparel industry. Since Lean is new to most of the Sri Lankan apparel manufacturers, the full benefit is not yet achieved. But current situation suggests that the industry can go forward with Lean.

Keywords- Lean Manufacturing, Lean tools and techniques, Apparel industry, Sri Lanka

I. INTRODUCTION

The apparel industry faced considerable changes as a result of the removal of Multi Fiber Agreement in 2005. Delivering high quality garments at low cost in shorter lead times are the major challenges faced by the apparel manufacturers. Most of the apparel manufacturers are trying to achieve these challenges successfully.

The apparel industry has one of the very complicated manufacturing processes. It is highly labour intensive and depends on the skills of human. The industry contains lots of wastes. As a result even it sounds simple, implementing successful process is challenging but there is an opportunity for improvement.

In 2008, global recession badly affected almost all the apparel manufacturing industries in the world. Due to that demand for the low cost garments are increased by the customers. Suppliers are forced to deliver low cost garments. Because of high cost factor in Sri Lanka, most of the companies faced difficulties in getting orders and some companies were closed down. In recent past Sri Lanka lost the Generalized System of Preferences Plus (GSP+) concession; reduced tariff benefit from European Union (EU). As a result the Sri Lankan apparel industry is in big dilemma. There is a risk of losing jobs of many employees work in this industry. The companies are seeking ways to minimize their cost in order to meet the competition by

other low cost countries such as China and Bangladesh and to survive.

In order to face this global challenge, most of the local apparel manufacturers have adopted different strategies. Lean Manufacturing is one of the techniques that is getting popular among local apparel manufacturers. It helps to achieve low cost, short lead times and improved quality. Lean Manufacturing can be defined as "A systematic approach to identify and eliminate waste through continuous improvement by flowing the product at the demand of the customer." (Introduction to Lean, 2010)

A. *Background of the Research Problem*

Lean manufacturing is a new concept to Sri Lankan industries. As a result there is no much study done on its suitability in Sri Lankan context. Lean manufacturing consists of tools and techniques which are introduced by Toyota. These tools and techniques must be managed and used carefully in order to prevent potential failures. In this research, the authors try to identify the factors that influence the implementation of Lean Manufacturing in Sri Lankan apparel sector. After completing this research it is expected to add more and new knowledge to the existing knowledge base in the apparel industry in Sri Lanka.

B. *Problem Statement*

Based on the above explanation a broader research problem can be stated as: "How can Lean Manufacturing tools and techniques be effectively used in Sri Lankan apparel industry to face the global challenge?"

C. *Research Objectives*

In answering the research problem, the study sought to accomplish the following research objectives.

- To identify the Lean tools and techniques which are introduced to companies and the order of implementation
- To explore the reasons to choose line wise, section wise, department wise and company wise the above mentioned tools
- To identify the level of sustainability of Lean Tools and techniques
- To examine Lean implementation strategies that suits Sri Lankan apparel sector
- To identify some of the main issues involved in the execution of those tools and techniques and to find out ways to overcome those issues
- To identify the benefits achieved after implementing Lean Manufacturing in apparel sector in Sri Lanka

II. LITERATURE REVIEW

Lean uses practically proven tools and techniques to systematically implement these Lean principles. If these are correctly applied, it will bring improvements to quality, cost and delivery of the final product. Those tools help in implementing, monitoring, and evaluating Lean efforts and its results. On the other hand if these were used without proper understanding, it can spoil Lean efforts in one's organization. Some of the tools and techniques that are used by organizations are 5S, Poka – yoke (Error proofing), Kaizen (Continuous improvement), Takt time, One piece flow, Pull system and Just-In-Time (JIT).

It is clear that almost every organization can adopt Lean Manufacturing to improve their businesses. After going through the literature, it is evident that Lean Manufacturing is still somewhat new to world. But it can be seen that usage and implementation of almost all Lean tools and techniques have been increased annually. (Womack, 2005)

Metal related industries are ahead in implementing Lean tools and techniques compared with other industries. Paper and allied products, stone-clay-glass products, textile mill products, printing, petroleum products, metal fabrication are the industries lag behind in implementing Lean Manufacturing concepts. (Silva, 2011)

Reviewing about the local context, Lean Manufacturing is relatively new to Sri Lanka. Only handful number of companies has implemented Lean in Sri Lanka. It can be seen that apart from the other organizations, many apparel organizations have taken lots of initiatives to implement Lean Manufacturing in their organizations. But the most common mistake they have made is that they try to adapt the tools of Toyota Production System without adapting the underlined philosophy of Lean Manufacturing.

It was found that even though most of the manufactures have implemented most of the Lean tools and techniques, the level of implementation and usage is varying. It is due to economic, operational or organizational factors such as challenging economic conditions, high levels of demand uncertainty, high –mix, low volume product portfolios, organization size and rigid organizational structures. (Silva, 2011)

III. RESEARCH METHODOLOGY

Sample

Since the number of Lean implemented garment factories is around 20 (< 30), it is difficult to undertake statistical tests and fifteen companies will be selected as the sample, based on judgmental sampling procedure. These can be recognized as one of the most expertise plants in apparel manufacturing. Also these companies have somewhat longer experience in implementing Lean compared to others.

Data collection

Data is collected through multi-methods in which interviews, questionnaires and observations are used. Initially a pilot study was done by distributing the questionnaire among the selected organizations. According to the results of the pilot study, the questionnaire was

revised. The questionnaire was composed of close ended questions as well as open ended questions. The questionnaire is answered by experts who have proper background, understanding and implementation experience of Lean Manufacturing System. In order to facilitate transcription process, all the conversations between the author and the interviewee were recorded. Partially Grounded Theory technique is used to clarify the data collected from different sources and some respondents were again interviewed to obtain missing data.

Data analysis

The responses gathered were analyzed using qualitative data analysis techniques such as comparison, naming and memoing. Graphical means were used to illustrate the relationships between variables using the Excel software.

Validity and reliability

Credibility of the research is very important and it is a requirement to show the readers that the study was reliable and the results were valid. The research is done by interviewing the key persons who involve in implementing Lean Manufacturing in reputed organizations. Peer debriefing and conformability techniques were used to check the consistency of data gathered from different sources. So the gathered data is valid. If a similar study would be conducted once again with the same sources the results would probably be the same. Thus it leads to a conclusion that the data gathered to be reliable.

IV. RESULTS AND DISCUSSION

Findings and discussion in relation to research objectives of the study is presented below.

1. Identify the Lean tools and techniques which are introduced to companies and the order of implementation

Most of the industries (90%) tend to implement 5S and other visual management tools initially. These tools are the instant winners which can easily make visible shop floor changes and quickly influence the financial status of the organization. This is same as Canada, USA and India (Womack, 2005; Thornton, 2006-2007). Next, operation stability and continuous flow must be achieved via takt time, one piece flow, cellular manufacturing, etc. Heijunka must be implemented at last which requires stability, standardization and pull production (Table I)

SMED is very popular in apparel industry in Sri Lanka. This is quite contradictory compared with the global situation (Dodd et al, 2008). The reason may be those countries use heavy machinery and SMED is not very popular due to a belief that improving changeovers requires a large investment in new machinery or tooling.

TABLE I. ORDER OF IMPLEMENTATION

Stage	Tools to be implemented
1	5S, VSM
2	Takt time, One piece flow, Cellular manufacturing, SMED, Team work
3	Kaizen, Pull system, Standard work, Kanabn, Visual displays & controls
4	TPM, JIT, Supplier integration
5	Jidoka, Poka-yoke, Problem solving
6	Heijunka

Source: Study Data, 2011

Moreover implementation order is almost same for any industry which is stated by Womack and Jones (Womack and Jones, 2003). But the organizational culture must be thoroughly analyzed before introducing any concept. Depending on the culture there may be slight modifications of the sequence Lean tools and techniques are introducing.

2. Reasons to choose line wise, section wise, department wise and company wise the above mentioned tools.

Companies have introduced most of the Lean tools and techniques line wise. (Fig. 1) The major reason for doing that is, they can run the particular line as a pilot line before deploying the Lean concepts to the whole factory. Also it prevents mistakes affecting bulk production and also the progress can be shown to others. Other reasons are the ease of implementation and ease of awareness as it is limited to a small area. Tools like VSM were introduced to the entire factory as to get a clear idea about the whole operation.

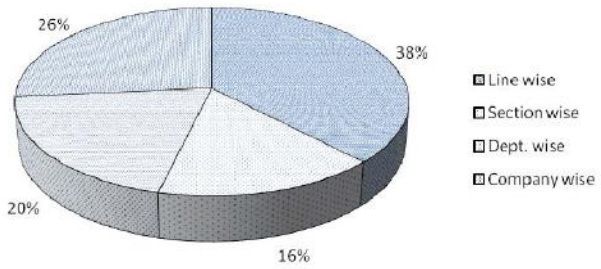

Figure 1. Method of introduction (n=15)
Source: Study Data, 2011

3. Identify the level of sustainability of Lean tools and techniques

Most of the tools and techniques have been sustained for most of the companies for more than 1 year. (Fig. 2) Also it can be seen that sustainability is a problem for some tools which is a global issue. It is found that one piece flow is difficult to sustain. The main reason is the operational stability is not achieved 100%. This is due to

inadequate change in the culture which must be gradually happen while implementing Lean concepts.

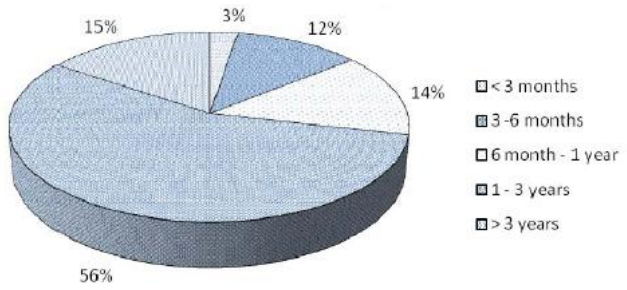

Figure 2. Sustainability (n=15)
Source: Study Data, 2011

4. Implementation strategies that suits Sri Lanka

Lean Manufacturing has been implemented by various means in Sri Lankan apparel industry. (Fig. 3) The experts are hired from outside consultancy firms and are highly trained in Lean concepts (20%). Some training is provided by in-house Lean champions via belt programs (25%) which are limited to some organizations. Most training combines classroom learning with shop floor practical exercises that provides instant payback. Best practise involves developing a culture that encourages experimentation and embraces failures as a learning experience which leads to employee empowerment.

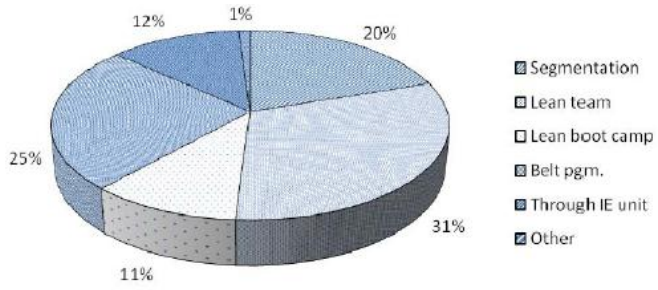

Figure 3. Implementation method (n=15)
Source: Study Data, 2011

5. Challenges in implementing Lean

It can be seen that the backsliding (13 %) is one of the main barriers in implementing Lean around the globe including Sri Lankan apparel industry. (Fig. 4) Lack of implementation know-how (12%), supervisor resistance (11%) and middle management resistance (9%) are the next influenced factors. This is because most of the humans are reluctant to change. There is less senior management resistance (7%) in implementing Lean in all the countries as well as Sri Lankan apparel industry. (Silva, 2011; Thornton, 2006-2007; Womack, 2005)

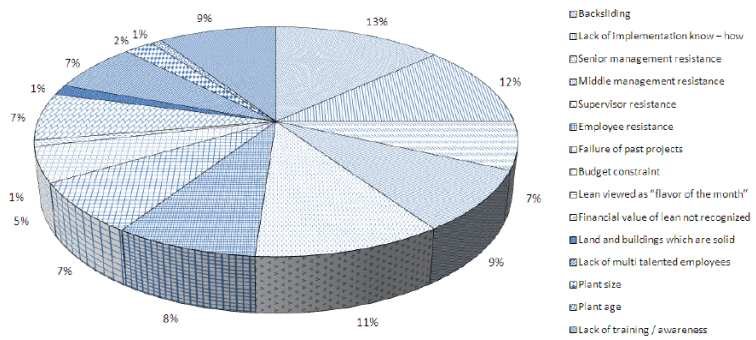

Figure 4. Challenges (n=15)
Source: Study Data, 2011

6. Ways to overcome those challenges?

Conducting workshops (22%), delivering presentations (20%), and belt programs (19%) are the most practiced ways to overcome the resistances of employees in implementing Lean. (Fig. 5) Most of the apparel manufactures have identified employees as their key assets. Employee empowerment programs have started by all the companies as this is essential in future Lean journey. Starting from training programs up to employee empowerment, a well structured human resource plan is necessary when implementing Lean practices. This must be done by human resource department in coordination with Lean teams.

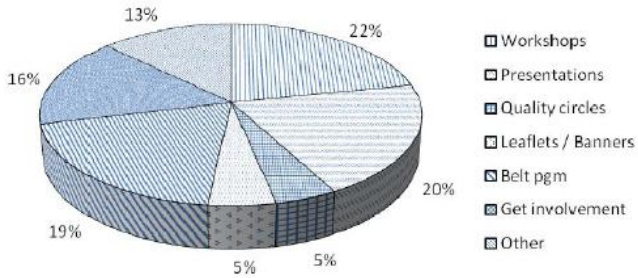

Figure 5. Ways of overcoming challenges (n=15)
Source: Study Data, 2011

7. Benefits achieved after implementing Lean

Organizations that have implemented Lean Manufactruing systematically, have been able to gain many benefits out of that implementation. (Fig. 6) the most achieved benefits are lower defects (14%), improved employee satisfaction (14%), lower inventory (13%) and lower lead time (12%).

5S, kaizen, Total Productive Maintenance (TPM) and problem solving are the most beneficial tools for apparel industry in Sri Lanka. 5S has led to improved workplace organization, reduction of space utilization and increased productivity. Poka-yoke techniques has reduced defects and improved employee satisfaction. Kaizen is reportedly creating an operational cost reductions and productivity improvements while also raising shop floor morale and

employee empowerment. Takt time has been used successfully in line balancing and it will support JIT. One piece flow, pull system and cellular manufacturing provide a low Work-In-Progress (WIP) manufacturing solution that is particularly suited to low volume products in the same product family. Kanban has reduced raw material stock and simplified ordering of those creating some pull production. SMED has been used to make very significant reductions in setup times and it will support heijunka. TPM has been shown to reduce maintenance costs and machine downtime thereby increasing Overall Equipment Effectiveness (OEE). Regular reviewing of VSM will identify the non-value adding activities and kaizen opportunities. Visual controls and displays provide support in the workplace, simplifying many processes thereby saving time and money. Jidoka has increased production quality and productivity while ensuring on-time delivery. Problem solving techniques will help to eliminate operational variations in the process. Work standardization has reduced process variability while encouraging problem solving.

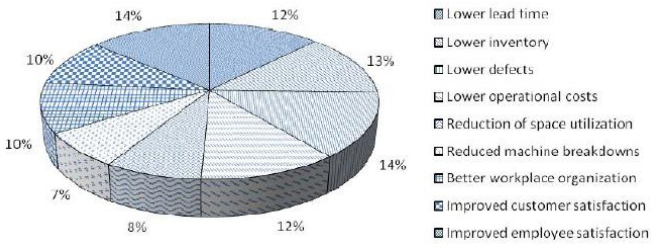

Figure 6. Benefits (n=15)
Source: Study Data, 2011

V. CONCLUSION AND RECOMMENDATION

Lean Manufacturing can be applied to mass production apparel industries and has made positive impacts in the sample apparel companies. As implementation of Lean concepts is still in development stage (less than five years experience), the full benefit is not achieved yet. But current situation suggests that the industry can go forward with Lean.

According to the selected apparel manufacturers, successful Lean implementation requires many factors such as introduction method, order of implementation, implementation method, etc. Therefore organizations of similar type in the industry can use the research outcomes as a knowledge base to overcome the problematic areas. Findings of this research can be valuable to other organizations of Sri Lanka, which hope to implement Lean in the near future. Also the results can be used as extra guidelines to those who already practice Lean unsuccessfully in the apparel industry. However there is a need to undertake further studies to confirm these findings since the present study is based on a small sample.

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