

EFFECTIVENESS OF LEAN MANUFACTURING LAYOUT OF A FIRM WITHIN THE APPAREL INDUSTRY OF SRI LANKA: A CASE STUDY

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Abstract

The study is based on Sri Lankan apparel manufacturer ABC and its SBU of Best Clothing to identify the effectiveness of a lean layout. Apparel export industry is the most important and dynamic contributor to Sri Lanka's economy. The share of the world market clothes and its share of exports of Sri Lanka are steadily losing since 2000. The imports to US from Sri Lanka have reduced by 1 % in 2015.

The time has come for Sri Lanka to look beyond the ordinary clothes and move from low -cost strategy. Retailers are demanding more on increasing for short lead times, to meet the customer demand. They prefer in maintaining a low inventory, material just in time at a low cost as to reduce the tax and increasing interest rates. Effective facility layout design reduces manufacturing lead time, increases the quantity and efficiency of the plant.

In today's society no style longs for more than a week. Four fashion seasons namely spring, summer, fall, winter is blending out 52 "micro-seasons" per year. For a style changeover, an effective layout is set to reduce the loss in efficiency because it will minimize the changeover time by developing multi skilled employees and easy changeover of machines with the size of the layout.

Therefore, the findings of this research show that there are two aspects that must be fulfilled for a lean layout to be effective. They are better organizational performance and contented employees. The organizational performance was measured using quality, speed, flexibility, dependability and cost. The employee contentment was measured using safety and ergonomics, income generated, relationship and support received from superiors, peers and supporting department, opportunity for skill development and career growth.

Key Words: Apparel Industry, Lean Layout, Retailers, Lead Time, Organizational Performance, Contented Employees

Introduction

The researcher has chosen this topic to study the effectiveness of Lean manufacturing layout of a firm within the apparel industry of Sri Lanka. The research is focused on a famous Sri Lankan apparel manufacturer ABC and its SBU of Best Clothing. ABC holdings, one of the South Asia's largest intimate-apparel manufacturers, operating in 5 countries with more than 50,000 employees are based in Sri Lanka. The company has reached great mile stones in its lean journey and has done vivid improvements to the process and one of them is the lean manufacturing layout. Currently they are using 18 lean layout and 33 other types of layouts. They have not clearly identified the real benefits of the lean manufacturing layout. They are operating this method on the trial and error basis and have a need to find out the effectiveness of this layout type. In the economic environment the apparel industry whose direct customers are retailers, demand is increasing for short lead times and prefer in maintaining a low inventory and need material just in time at a low cost as to reduce the tax and increasing interest rates. Shorter lead times avoid losing business, and increase cash flow, having a continuous fast turnaround helps businesses gain grip and outpace their competitors. In the social environment, fashion trends in today's society no style longs for more than a week, according Elizabeth Clines Four fashion seasons namely spring, summer, fall and winter is blending out 52 "micro-seasons" per year. With the new trends coming out every week, the goal of fast fashion is for consumers to buy as many garments as possible. Hence the central theme of the study was to "Identify the effectiveness of lean manufacturing layout in the organization" with its specific objectives to;

- Ascertain the layout type that contributes highest to the organization performance.
- Determine the employee's contentment working in lean layout.
- Identify the relationship between employee contentment and lean layout effectiveness.

There were few limitations as limited literature that was available on this research topic and they were not freely accessible so the researcher has used the free sources to collect literature and this study is only done focusing on one organization SBU and the limited time.

Literature Review

Lean

Lean is defined as: “an integrated socio-technical system whose main objective is to eliminate waste by concurrently reducing or minimising supplier, customer, and internal variability” (Shah and Ward, 2007). “Lean production” which is a western version of the Toyota production system (TPS) introduced in Toyota Japan (Womack et al., 1990). Lean mainly focuses on eliminating wastes or Muda (Japanese term for waste) in the production process. There are seven types of waste that can be seen in an organization. They are Transportation (Unnecessary movement of the materials), Inventory (Materials not used to current orders), Motion (unnecessary movement of employees while they are working), Waiting (Waiting to begin the process), Over production, over processing (Doing more than what customer has requested and defects) (Womack and Jones, 2003)

Lean Layout

Lean layout also called as cellular manufacturing, a cell is a combination of people, equipment and workstations organized in the order of process to flow, to manufacture all or part of a production unit. It helps in reducing the work in process inventory in the layout by setting up a balanced flow of materials from machine to machine, Improved communication between the employees, better scheduling and material flow, better utilization of the machines, better surfacing of the problems with low work in process in layout, Reduces the throughput time and finally it helps in capability development of employees through multi skilling them. (Heizer and Render, 2003)

Organization Performance

Performance measures are categorized as financial performance measures and non-financial performance measures (Hall, 2008). In modular manufacturing in garment industries five performance objectives are quality, speed, dependability, flexibility and cost (Sudharshan & Rao, 2013).

Employee Contentment

The term contentment or employee satisfaction refers to as “the combination of affective reactions to the differential perceptions of what he/she wants to receive compared with what he/she actually receives”. Therefore, it is necessary that the organizations to source the employee expectations as to approach the employee satisfaction. (Judge, Cranny, Smith, & Stone, 1994)

Employee contentment is affected by many things such as salary, communication, autonomy, working environment, and organizational commitment. Safety and ergonomics are considered as factors that determines employee contentment at the layout. The relationship between peers, superiors and other department in a particular type of layout affect employee contentment (Friedlander and Margulies, 1969).

Conceptual Framework of the Research

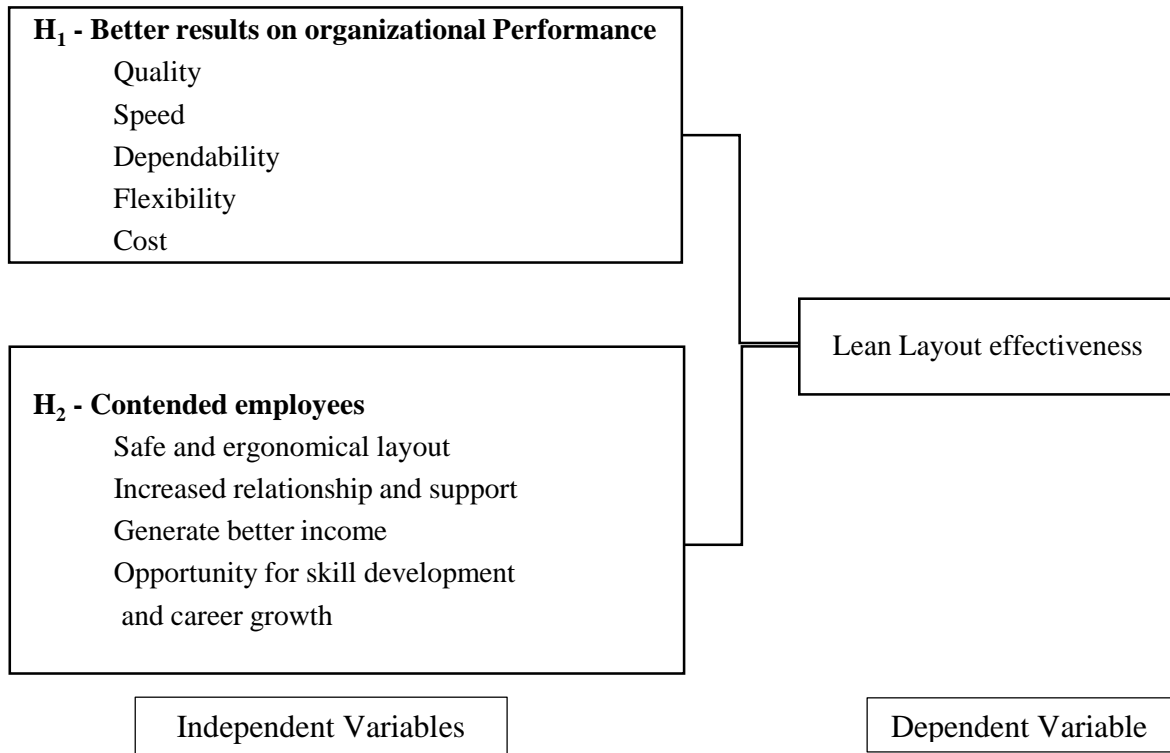


Figure 3 - conceptual Model

Source- Conceptualized by the Author

H₁: There is a positive relationship between organizational performance and lean layout effectiveness

H₂: There is a positive relationship between contended Employees and lean layout effectiveness

Methodology

Research Design

This study was mainly a quantitative research in descriptive format that uses relatively less complex and common statistical tools such as descriptive statistics, multiple regression analysis and correlation coefficients.

Population and Sampling

In this study, the author has taken Best Clothing of ABC Holdings which is located in pallekele as the population and strategic business unit or SBU of linea clothing is selected as the sample to measure the hypothesis. To measure the organizational performance variables, all the available layout types in that SBU is selected and the internal data base of “SAP data base” and direct observation has used to measure the organizational performance.

In order to measure the employee contentment, the author carried out a survey using a questionnaire. Five likert scale questions are included in the questionnaire. To identify sample population to do the survey on employee contentment a simple random sampling is done among team members who are currently working in those layouts. Sample size was 84 team members working in three layouts at

Best Clothing. Descriptive statistics and multiple regression Analysis and Correlation coefficients comparison are used to analyze the data.

Operationalization

Table 1: Operationalization

Hypothesis	Variable	Indicator	Measurement	Source	
1	Organizational performance decides the effectiveness of the lean layout	Quality	AQL(Acceptance Quality Limit) failure rate- (Number of pieces quality failed against the manufactured pieces)	Percentage (The lower the better)	SAP data base of the company
		Speed	Throughput time- (The time lapse for a piece to go from input to output of the module)	Minutes (The lower the better)	Direct observation
			Work in progress in module/layouts- (Number of pieces resting on machine table without adding value)	Number of pieces (The lower the better)	Direct observation
		Dependability	On time delivery to customer-(Number of orders reach the customer required date from the total placed orders)	Percentage (The higher the better)	SAP data base of the company
		Flexibility	Change over time- (Time taken from the last piece of the previous style to the first good piece of the new style)	Minutes (The lower the better)	SAP data base of the company
		Cost	Standard hours - (Number of hours manufactured by employee)	Hours (The higher the better)	SAP data base of the company
2	Contentment of employees decide the effectiveness of the lean layout	Safety and ergonomics	Safe and ergonomical lean layout makes employees contended	Likert scale 1-5*	questionnaire
		relationship and support from the peers, superiors and other departments	Increased relationship, support from the peers, superiors and other departments in a lean layout makes employees contended	Likert scale 1-5*	questionnaire

	Income levels	High income levels in lean layout makes employees contended	Likert scale 1-5*	questionnaire
	skill development and career growth opportunities	Increased skill development and career growth opportunities in lean layout makes employees contended	Likert scale 1-5*	questionnaire

*5=Strongly Disagree, 4=Disagree, 3=neither agree nor disagree, 2=Agree, 1=Strongly Agree
Source-Authors work

Result / Discussion / Analysis

To Ascertain The Layout Type That Contributes Highest To The Organization Performance. (SAP data base)

According to the structured questions asked 100% of the participants mentioned that there are 3 types of layouts. They are: Lean layout, Zig Zag layout, Straight line layout

The below are the designs of these types of layout.

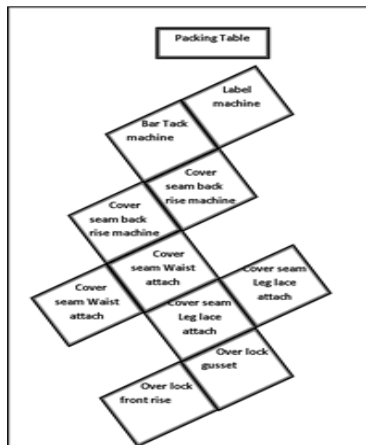


Figure 4 -Zig zag layout design
Source-Authors work

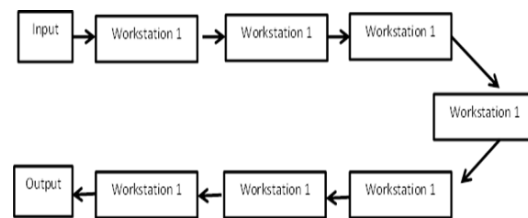


Figure 5 -Lean layout design
Source-Authors work



Figure 6 –Straight line layout design
Source-Authors work

Table 3-Summary of the performance objective rankings

Performance objective	Measurable	Lean Layout	Zig zag layout	Straight line layout
Quality	AQL	1	2	3
Speed	Through put time	2	3	1
Speed	WIP	2	3	1

Dependability	OTD	1	2	2
Flexibility	Changeover time	1	3	2
Cost	Standard Hours	1	3	2
	Average rank	1.3	2.7	1.8
	Final Rank	1st	3rd	2nd

Source-Authors work

According to the above table the highest contributing model to organization performance is lean manufacturing layout as it has the lowest ranking average of 1, then the straight line layout and finally the zig zag layout. So it can be concluded that lean layout is the highest contributing layout type to the organization.

To Determine the Employee's Contentment Working In Lean Layout.

The below shows the summary of employee agreeability of the above factors.

Table 4 -Employee agreeability on contentment working in lean layout

Variable	Mean value	Level of agreeability
Lean layout is Safe and ergonomical	2.3	Agree
Increased relationship and support from the peers, superiors and other departments is in lean layout	1.8	Agree
Working in lean layout Generate better income	2	Agree
Lean layout gives Opportunity for skill development and career growth	1.8	Agree
Employee are contended working in lean layout (Average)	1.975	Agree

Source-Authors work

According to the above table it can be concluded that employees are contended working in lean layout as the average of the mean value of the four variables that determines the employee contentment is 2 or agree as the rating scale taken.

4.3 To Identify The Relationship Between Employee Contentment Working In A Lean Layout To The Variables, Safety And Ergonomics, Income Level, Relationship With Other And Skill Development And Career Growth.

Table 5 -Hypothesis results

Variables	P value	Pearson correlation	Strength of correlation
H1- safety and ergonomics of lean layout impact Contentment of employees	.000	.470**	Weak positive relationship
H2-Relationship built and support received in lean layout impact Contentment of employees	.000	.529**	Moderate positive relationship

H3-Income generated in lean layout impact Contentment of employees	.002	.332**	Weak positive relationship
H4- Skill development and career growth opportunity in lean layout impact Contentment of employees	.000	.528**	Moderate positive relationship

Source-Authors work

According to the above table it is seen that all 4 variables taken to analyse has positive relationship or positive impact to the employee contentment of working in lean layout.

Conclusion and Recommendation

Since this study has focused on lean layout effectiveness, it can be concluded that the lean layout is effective and can be rolled throughout the organization and in other SBU's as well. Following recommendations are suggested to the organization and to its stakeholders.

- ❖ **WIP reduction**-The WIP levels of the lean layout is comparatively higher than the straight line layout. According to the lean principles, work in progress is a waste and it hides problems. If this is reduced, problems can be revealed quickly and solved timely. Unwanted motions, absenteeism, poor line balancing have noticed as the causes for this. Time and motion study can be done to create a proper visual process so that unnecessary movements can be eliminated. Make multi-skilled employees to work in a stable, reliable manufacturing process that consistently produces a quality product within the agreed-upon lead time. Job rotations can be done to make the employees aware on each of the production stage.
- ❖ **Improving the throughput time**-The throughput time of the lean layout is high compared to other types of layout this can also be a result of the work in process of the module, as to improve the through put time the organization can consider the line balancing or do time studies and method studies in order to improve the throughput time of the layout. When employees lack the necessary training, they may struggle to find improvements that they can make. Worse yet, undertrained employees may accidentally create delays because they don't understand the entirety of the production process and how a change or adjustment saves them a minute creates 5 minutes of extra work for someone else. Therefore, proper training and development is required.
- ❖ **Reduce the changeover Time**-Increased changeover time result in loss in standard hours produced according to experts, currently at the lean layout there is a changeover time of average 25 minutes this can be improved by preparing on machine setting and training of team members earlier to the changeover so it will reduce the changeover time, also the researcher would like to suggest to do an activity analysis to study the reasons for the changeover time and improve it more.
- ❖ **Improve housekeeping in modules**-The researcher observed deviations in housekeeping practices in the layout, there were no standards created to keep materials, and the cleanliness of the shop floor to be improved. The researcher would suggest demarcating the floor areas and aware the team on housekeeping practices, according to the lean house of Toyota production system housekeeping is a foundation to build a lean organization.
- ❖ **Improve safety conditions in lean Layout**-According to the questionnaire results the average for the question "Lean layout creates no accident" is where employees don't agree or disagree, but 15 (18%) of the respondents have disagreed with this statement, so the researcher would suggest the organization to further study on what areas the safety to be improved and give the necessary precautions in improving safety at the layout.

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