# Impact of Lean Manufacturing Practices on Operational Performance: A Study in Sri Lankan Apparel Sector

**SP Aryarathne[1*], NWK Galahitiyawe[2]**
*Department of Operations Management, University of Peradeniya[1*],*
*Department of Decision Sciences, University of Sri Jayewardenepura[2].*
*samurdhiea@pdn.ac.lk[1*], nilakshi@sjp.ac.lk[2]*

Received: December 28, 2021
Accepted: January 7, 2022

## ABSTRACT

This study aims to explain the impact of lean manufacturing practices on operational performances. Cross sectional data using a survey sample of 386 managers in the apparel sector with a simple random sampling were used. Data were analyzed using SPSS and Structural Equation Modeling. Study also has tested the criteria of goodness of fitness with absolute, parsimony and incremental fit indices. Results indicates that there is a positive impact of lean manufacturing practices towards operational performances ($\beta$=0.49). Findings add value to the theories of lean manufacturing and knowledge based view providing solid recommendations to practitioners on adopting lean manufacturing practices.

***Keywords*:** Lean Manufacturing practices (LM), Operational Performances (OP).

## 1. Introduction

The global business organizations are focusing to thrive the competition while enhancing the performances. This competition has made many organizations to bring new strategic weapons to remain keeping the top in the competition or to climb the ladder of competition. One such introduced to the business world is lean manufacturing. This was first brought to the world by Toyota Production System. (Falah Abu et al; 2019).

Different Asian countries that is considered to be the masters in producing the mass and customized products at the lowest possible prices (Farias et al., 2019) have adopted LM in their process effectively. This has been helped by their extensive adoption of LM practices, because LM practices are especially advantageous in companies that are mass producers of products. Researchers including. (Caldera et al., 2019) have documented, that even a reduction of 23seconds within the production process can result in huge financial savings with LM practices.

Lean Manufacturing focus on key areas for which improvement is needed and to explore the non-value-added activities, to eliminate those activities or processes, which do not contribute to increasing the production systems value (Mangla et al., 2019).

The implementation of a lean strategy, like any other productivity improvement initiative, aims on the elimination of everything that does not add value to the product or service. In many companies the major focus of lean implementation is still the shop floor and their search for competitive advantage has yet to rely on the more recent lean integrative approaches (Hines et al., 2018).

The performance gap was identified with the five years‘ key performance indicators (KPI‘s) related to operational performances in a selected apparel manufacturing organization in Sri Lanka that have adopted lean manufacturing techniques and tools, that operational performances have improved only to a very small percentage, and the expected level of performance has not been met.

**Table 1: Operational Report 2015-2019**

| KPI | 2015 | | 2016 | | 2017 | | 2018 | | 2019 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Actual | Target | Actual | Target | Actual | Target | Actual | Target | Actual | Target |
| First Time Through (FTT) | 70% | 92% | 74% | 93% | 75% | 94% | 78% | 95% | 80% | 96% |
| Delivery in | | | | | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Full On Time (DIFOT) | 90% | 100% | 87% | 100% | 83% | 100% | 85% | 100% | 81% | 100% |
| Overall Equipment Efficiency (OEE) | 65% | 80% | 67% | 80% | 72% | 85% | 78% | 85% | 79% | 90% |
| Scrap Rate (SR) | 12% | 7% | 12% | 6% | 10% | 6% | 11% | 3% | 9% | 3% |

The knowledge gap lies from the theories of lean manufacturing and knowledge based view. The theory of lean manufacturing illustrate manufacturing process without waste. The consumption of resources without value creation are named as waste and need to be excluded from the process. Majority are predominantly practiced in the automotive industry. This is starkly evident in the investigation by Henao et al. (2019) out of the 679 articles, 3% of the literature indicated being related to the furniture, machinery, foundry, and logistic industry. There are eight types of wastes that can be occurred in respect to this theory. Hence how the lean manufacturing could bring operational performances is questionable in theoretically.

The theory of knowledge based view (KBV) is essential for an organization to develop new product and solve problems. This theory explore how an organization acquires knowledge from external sources such as suppliers, customers, competitors and how those knowledge can be used in business context. (Roy & Sivakumar 2010; Sivakumar et al. 2011). Since the lean manufacturing has been explores as new knowledge base to an organization how this knowledge could utilize in bringing out the real operational performances is need to be examined. (Snell & Moriis, 2014).

With the above performance and knowledge gaps several question become unanswered, nnamely; Can lean process implementation drive operational performance in an organization? How do organizations achieve continuous improvements in results utilizing these implementations? (Nabass & Abdallah 2017).

Considering the above mentioned unanswered questions, theories on lean manufacturing and knowledge base view are still relatively sparse, as the assumptions used in these theories (Lotfi & Saghiri 2017). It would seem that solutions should be sought at more abstract levels of these theories that deal with lean manufacturing and their mutual relationship with operational performances. (Browaeys & Fisser 2012, p.210).

Hence the problem statement of the study is: ―Is there is a relationship between lean manufacturing practices and operational performance‖ in the apparel sector in Sri Lanka.

The problem statement of the study focusses on finding the answer on the relationship between the variables lean manufacturing practices with operational performances. The lean notion has always been linked to operational performance (Shah and Ward, 2003). While numerous studies have empirically shown the effectiveness of internal lean practices on operational (Shah and Ward, 2003; Kannan and Tan, 2005; Swink et al., 2005).

## 1.1 Research Question

- What is the impact of lean manufacturing on operational performance in the apparel sector in Sri Lanka?

## 1.2 Research Objective

- To measure the relationship between lean manufacturing practices and operational performance in the apparel sector in Sri Lanka.

## 1.3 Significance

The majority of studies in the field of operations management published in the last four years, from 2014 to 2019, have been on lean manufacturing. A consistent upward trend in publications has been observed since 2012, with the number of papers peaking in 2016. This demonstrates a significant growth of interest in lean manufacturing research that has now spread to new fields as agile manufacturing as well (Doman 2017, p.122; Khurma et al. 2017,p.12).

Most of these studies were not based on any theories or concepts that could investigate lean manufacturing, on operational performances. Thus, they lacked a theoretical foundation (Browaeys & Fisser 2012, p.210).

Many studies on LM framework development (Johansen and Walter, 2007; Gao and Low, 2014; Yadav et al., 2017) were conceptual and were not verified, this creates uncertainty among company leaders in regard to LM‘s adoption. Although, several researchers (Zargun and Al-Ashaab, 2013; Alhuraish et al., 2017) identified drivers for successful LM adoption, few modelled them into a framework. Research teams (Gandhi et al., 2018; Caldera et al., 2019) identified the weights of different LM drivers but did not explore the inter-relationships among them, which generated uncertainty about their behavior during LM adoption processes.

The above mentioned aspect is lacking as a single model in the apparel sector, and therefore, the generation of new knowledge from the study will fill the identified gap in empirical knowledge. Thus, the study will generate new knowledge and will enhance the value added processes in the apparel sector.

## 2. Literature Review

### 2.1 Lean Manufacturing Practices (LMP)

Over the course of time, a number of prominent researchers have explored the various range of tools for lean manufacturing (LM), since it has successfully proved in a large variety of industries with many successful cases recorded in the literature (Pearce et al., 2018)

The main purpose of lean manufacturing is to eliminate waste, which is known as muda in Japanese. Improvement of quality and productivity and better responsiveness in terms of results is the ultimate objective of this implementation. (Tapping, 2006). The seven types of waste in lean concept are over production, over processing, inventory, motion, transportation, waiting, defects, unutilized human resource. The impact of lean manufacturing practices as evidenced in most empirical research proves that organizations can achieve competitive advantages while delivering a better service (Doolen & Hacker, 2005).

According to Bertelsen and Koskela (2003), lean manufacturing aims to increase efficiencies by eliminating waste. Anything that does not add value to a process in point of customer view is defined as waste. This has been pertinent in a wide region since the most logic behind the setting is continuously an efficient approach that decreases the ‗total cost' concept, one that ignores individual cost structures and focuses on the total cost of delivering value to the customer (Goldsby & Martichenko, 2005).

Based on the literature, ten lean manufacturing practices dimensions were identified for this study: customer involvement, employee involvement, supplier involvement, pull system, 5S, Total productive maintenance, statistical process control, single minute exchange die, visual management and production leveling (Yadav et al; 2018).

The studies of Womack and Jones (as cited by Tapping 2019) presented the six lean principles: value, the value stream, product, flow, pull and perfection, described in the following way:

- Value is defined by the ultimate customer;
- The value stream is the set of all specific activities required to bring the process to a specific level;
- Product is defined through the internal value chain;
- Flow is about making the value-creating steps flow;
- Pull refers to using a pull schedule; and
- Perfection is concerned with making improvement a continuous effort Lean manufacturing is considered to be a holistic business strategy implemented in order to improve performance (Rahaman et al. 2018), emphasizing excellence through continuous improvement and elimination of waste by applying lean principles and tools (Fullerton et al. 2014).

To achieve the objective of lean manufacturing, different organizations use a number of tools such as kanban, 5s, visual control, poke yoke, SMED (Single Minute Exchange of Dies), the pull system, and Total Productive Maintenance (TPM). When the concept of lean manufacturing evolved initially, scholars actually identified it as a ‗lean philosophy,' from which ‗lean behavior' and

‗lean thinking‘ later evolved. There are five basic concepts that define lean thinking and enable lean production (Andersson et al. 2006). They are:

- Specifying value;
- Identifying the value stream;
- Flow;  Pull;  Perfection.

**2.2 Operational Performances (OP)**

Operational Performance have been characterized by numerous scholars but comparable characteristics on the definitions can be recognized. Operational Performance can be defined as the definition ―implementation and utilize of execution measures on the level of day-to-day operations‖ (Hussain & Abdallah, 2018).

Operational performances was defined by Feng et al. (2008, p. 26) as the ―performance related to organizations‘ internal operations, such as productivity, product quality and customer satisfactions‖. Mabin and Balderstone (2003) explained the concept as throughput, inventory, and operating expense.

Organizations try to develop a vital change and operational performances (Naranjo-Gil et al., 2008). ―The implementation and use of performance measures on the level of day-to-day operations‖ was defined by de Leeuw and Berg (2 011) which was taken to this research study purpose.

Study has taken the dimensions in operational performances as; cost, quality, delivery and flexibility for manufacturing companies. (Hussain & Abdallah, 2018)

**2.3 Hypotheses**

**2.3.1 Lean manufacturing practices on operational performances** Effective strategies for lean performance evaluation should be adopted and the performances should be monitored by estimating its costs and by promoting different lean approaches as ‗Just-In-Time,‘ to minimize inventory storage costs (Yadav et al., 2018) as the strategic preferences or dimensions where an organization select to compete. Hence, strategic alignment on manufacturing capabilities and competitive priorities is important in order to achieve competitive advantage. (Hu et al. 2002).

Several studies have highlighted the positive association between LM and measures of operational performance, such as quality (Negrão et al., 2017) and inventory turnover (Demeter & Matyusz, 2011; Yang et al., 2011). However, although LM practices on average lead to better operational performance, implementing LM in isolation is not sufficient if firms seek the breakthrough improvements characterizing a true lean enterprise (Jones and Womack, 2017).

Pull-production systems are highly supported by JIT techniques (So and Sun 2010) such as controlled material flow and the production of small lot sizes, which allow manufacturing to synchronize production with the demand rate (Kannan and Tan 2005; Jayaram et al. 2008).

Since many scholars have tested and proved the effective use of lean manufacturing practices on the impact of operational performances. (Flynn et al. 2005; Huson and Nanda 1995; Cua et al. 2001; Shah and Ward 2003; Kannan and Tan 2005; Swink et al. 2005).

The hypothesis is developed to validate whether lean manufacturing practices have an impact on operational performance in the apparel sector in Sri Lanka.

H1: Lean manufacturing practices have an impact on operational performance.

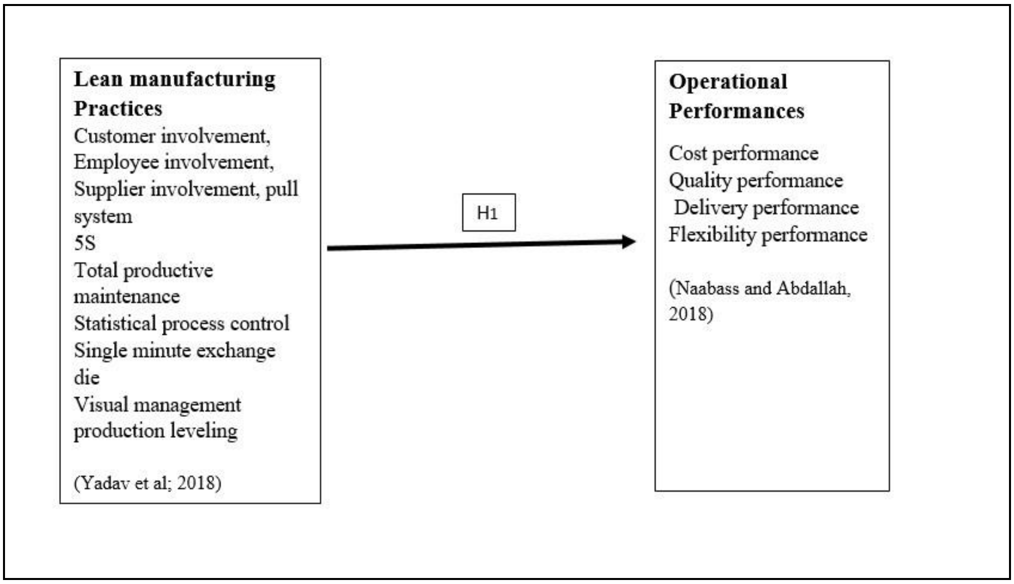


**Figure 1. Conceptual Model**

Figure one shows the conceptual model developed on the relationship between lean manufacturing practices and operational performances.

## 3. Research Methodology

The significance of the research methodology is outlined based on the model on research onion by Saunders et al., 2009. As per the nature this study falls in to the positivist paradigm. This is often when a researcher is working on observable social realities and the end result can be generalized to similar contexts. Moreover, the researcher is not a part of the issue being examined; rather watches the circumstance freely, being out of the specific situation, so as to maintain a strategic distance from individual bias in portraying the issue. Thus, the researcher is part of the objectivist ontology. (Saunders et al., 2009).

Survey has been taken as the research strategy on this study. This strategy has been answering to developed research questions and theory testing which is the fundamental approach on this study which falls in to deductive approach. (Saunders et al., 2009).

In the current research study, the researchers have used the mono method, where quantitative data and a quantitative data analysis procedure was used to answer the research questions as the data collection technique. (Saunders et al., 2009).

Research study is a cross sectional study as the research time horizon which takes a snap shot. A cross-sectional study involves looking at data from a population at one specific point in time. The participants in this study are selected based on particular variables of interest. (Saunders et al. 2009).

### 3.1 Sampling

The population for this study was taken from the apparel sector. The apparel manufacturing plants where the lean manufacturing practises has been already implemented was taken as the population for this study. Population of the study is seven hundred fourteen (714) apparel manufacturing plants with lean manufacturing implemented by 2019. Sample from the population is selected from the probability sampling technique; simple random through a sampling table. Sample size is selected based on two criteria‘s. Since the questionnaire is having fifty five (55) questions, based on Hare‘s model (2014) 55 items x5= 275 minimum of sample should be taken. In order to fulfill the analysis from AMOS at least 150 sample size should be incorporated. With this, a minimum of 275 sample size was taken in to this study. Gathered sample size finally ended up with 386.

### 3.2 Data Collection

Unit of analysis for the study was taken as plant level. Questionnaires were distributed to managerial level and above category. Questionnaire consisted ten Lean Manufacturing Practices as Customer Involvement, Employee Involvement, Supplier Involvement, Pull, 5s, SMED, Statistical Process Control, Total Productive Maintenances, Scheduled Production and on Operational performances as Cost, Flexibility, Quality, Delivery. with According to Suifan et al. (2015) studies testing on the organization perspective should be incorporated with the information from decision level category of the organization which was collected through managers.

This research uses the following data analysis techniques; descriptive statistics, test for normality, outlier test, reliability test, and hypothesis testing using Structural Equation Modeling (SEM).

Structural Equation Modeling is compatible with the present study owing to its many suitable attributes. Firstly, it utilizes a confirmatory rather than an exploratory data analysis, which helps it fit with hypothesis testing. In contrast, exploratory factor analysis can be seen in most other multivariate strategies.

Secondly, SEM can provide explicit estimates of error variance parameters, and it can handle measurement error problems much better than traditional multivariate procedures (Byrne 2010). However, traditional multivariate methods such as regression assume that the errors in the explanatory variables vanish. Finally, traditional methods analyze only observed measurements, whereas SEM allows for analyzing both observed and unobserved variables

### 3.3 Measurement Model

Study variables were measured at 7 point likert scale for the two types of constructs. Figure one presents the developed conceptual framework to operationalize the variables. In order to overcome Common Method Variance (CMV), at the questionnaire designing stage procedural remedies were taken.

This is to ensue respondent‘s anonymity is reduced providing proper instructions to psychologically, separating the measures . Hence Herman‘s single factor test was carried out to confirm the questionnaire does not carry out any common method variance. Pre Test was conducted by sending the questionnaire to five people including three operations managers and two operations related managers at five manufacturing companies, for their comments and was changed according to the feedbacks. Pilot test was conducted with 50 questionnaires and analyzed using the statistical package SPSS version 23. In the analysis of the pilot test, the reliability of the measures was checked for each construct through Cronbach's alpha. A satisfactory level of reliability was obtained through a Cronbach's alpha of 0.7 or above (Hair et al; 2014) Therefore, questionnaire assured the internal consistency.

## 4. Analysis

Descriptive data analysis indicates that 60% of the sample has 1-5 years experiences in the industry and 69% has 1-5 years experiences in lean manufacturing practices implementations.

Data were filtered through testing and assuring missing values, outliers. Further normality, linearity, multicollinearity and homoscedasticity were ensured as essentials on conducting the Structural Equation Model multivariate assumptions. These tests were carried out by SPSS 23 version. Sample adequacy were tested through KMO which the values indicated were accepted (LMP-0.908, OP- 0.905) with the criteria (0.5 or above as accepted). Barlett‘s test of sphericity were less than 0.05 (LMP and OP-0.000) ((Hair et al; 2014).

Exploratory Factor Analysis (EFA) was performed and satisfied with respect to each construct to test the factor structure and confirmed the unidimensionality of measures Using AMOS 23.0 measurement and structural models were developed. Explanatory factor analysis was conducted using principal components analysis (PC) as the extraction method and Varimax with Kaizer normalization method as the rotation method. EFA for lean manufacturing practices, and operational performances were evaluated. Lean manufacturing was measured with ten dimension of scales and EFA was loaded to eight factors. Operational performances was measured with four dimensions as cost, quality, delivery and flexibility where EFA was loaded to only two factors. This indicates that the lean manufacturing and operational performances concept are illustrated through the dimensions as indicted as a whole.

Measurement model was tested with Confirmatory Factor Analysis to the contribution of each scale item as well as incorporate how well the scale measures the concept which is simply assuring the reliability with the indices of absolute fit, incremental fit, parsimony fit.

Absolute fit indices are a direct measure of how well the model specified by the researcher reproduces the observed data and also it provides the most basic assessment of how well a theory fit an empirical data (Hair et al. 2014). Incremental fit indices differ from absolute fit indices in that they assess how well the estimated model fits relative to some alternative baseline model (Hair et al. 2014). Further, Hair et al. have stated that Tucker-Lewis Index (TLI) and Comparative Fit Index (CFI) are the most widely reported tests under incremental fit indices.

Parsimony fit indices, which is the third group of indices, designed specifically to provide information about which model among a set of competing models is best, considering its fit relative to its complexity, the parsimony ratio is the basis for these measures (Hair et al. 2014).

**Table 2. Initial to final model values**

| | **GOF Measure** | **Initial Model Values** | **Final Model Values** |
|---|---|---|---|
| **Absolute fit indices** | CMIN/DF | 3.138 | 2.456 |
| | GFI | 0.506 | 0.806 |
| | AGFI | 0.444 | 0.473 |

| | | | |
|---|---|---|---|
| | RMSEA | 0.116 | 0.069 |
| **Incremental fit indices** | IFI | 0.606 | 0.806 |
| | CFI | 0.603 | 0.853 |
| | TLI | 0.565 | 0.905 |
| **Parsimony fit index** | PRATIO | 0.912 | 0.896 |

***Source: Survey data, 2019***

Table 2 indicates that the values are within the standard ranged defined by Hair.et al; 2014. Value of CMIN/DF is below 03 and closer to 01, the values of GFI and AGFI are closer to 0.9 and the RMSEA vale is well below 0.08 assure the absolute fit. On the other hand, values of IFI, CFI and TLI have almost surpassed 0.9 indicating the incremental fit of the model. Finally, PRATIO is also closer to 0.9 affirming the parsimony fit of the model. According to Hair et al. (2014) more complex models with larger samples should not be held to the same strict standards, and so when samples are large and the model contains a large number of measured variables and parameter estimates, cutoff values of 0.95 on key GOF measures are unrealistic. Hence it can be concluded that the final measurement model fit satisfactorily.

Reliability was tested to assess how highly interrelated the indicators are used together to measure their associated construct (Hair et al, 2014). Given the recommended Cronbach‗s alpha greater than 0.7 (Hair et al; 2014), study shows acceptable reliability, with the coefficient alpha for more than 0.7 for all dimensions.

The respective Average Variance Extracted (AVE), Composite Reliability (CR) and Discriminant Validity (DV) measures of the constructs in the final measurement model were above the threshold of 0.5 and similarly CR values are above 0.6 for which indicates validity of the dimensions. In order to test the discriminant validity AVE values of the variables were compared with the square of the correlation estimate between these variables. The AVE values for each variable are higher than the square of the correlation between that variable and other variable. Thus, all the variables in the study represent different concepts and there are no problems with discriminant validity.

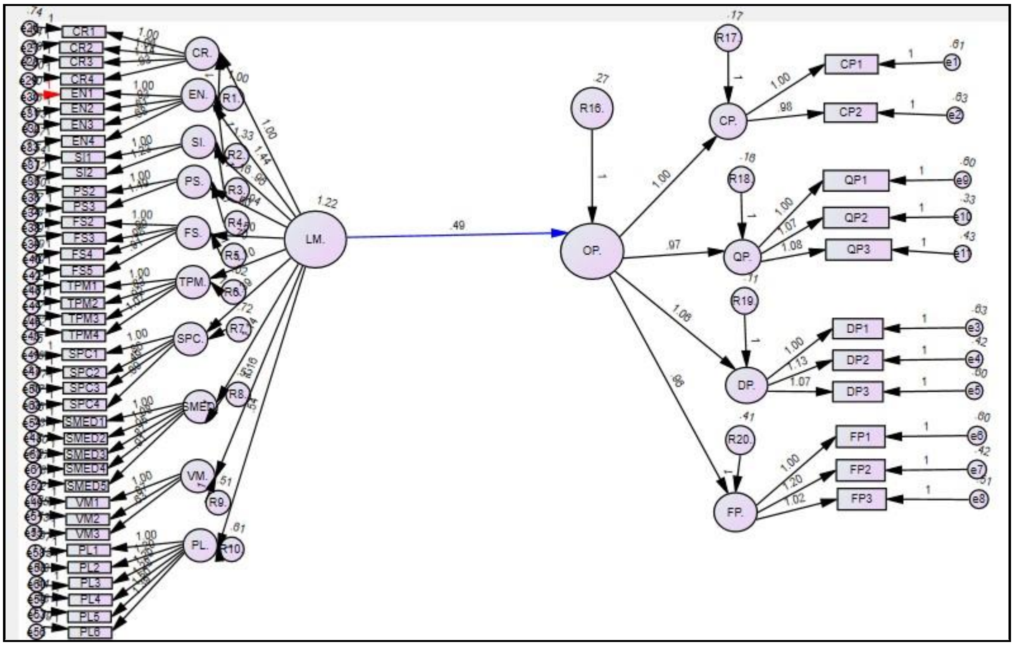


**Figure 1. Structural Equation Model**

Figure 1 in the current study, the proposed structural model is composed of two major latent constructs, of which exogenous (LMP) and one is endogenous (OP). The fit indices indicated that the structural model had a good fit with the data on structural model structural model (($\chi 2$/df = 2.160, CFI = 0.911, GFI = 0.833, RMSEA = 0.065) thus supporting the basic theoretical model of the study.

Table three presents the results of testing the hypothesized direct relationships among Lean manufacturing practices (LM), and Operational performances (OP). The table also includes the standardized path coefficients, β values, and the corresponding significance levels.

**Table 3. Hypotheses Test Results**

| Path | Hypothesis | β | p-value | Result |
|---|---|---|---|---|
| LM → OP | H1: Lean manufacturing practices has an impact of operational performance. | 0.49 | .001** | Accept |

**P<0.05

Hypothesis 1 investigated the relationship between lean manufacturing practices (LM) and operational performances (OP). It was hypothesized that there would be a relationship between lean manufacturing practices and operational performances. The results demonstrates a positive and significant path ($\beta$ =.0.49, p value of 0.001). Thus, hypotheses 1 was supported.

## 5. Discussion

The research question covers the relationship between lean manufacturing practices with operational performances.

The literature supports that the operational performances has been explored as a strategic weapon to be used to face the competiveness. This needs a proper strategic alignment on manufacturing capabilities and competitive priorities. (Narasimhan and Das, 2001).Many empirical studies have proven that when there is an effective and efficient lean manufacturing practices it drives towards achieving the operational performances. (Flynn et al., 2005; Huson and Nanda. 2006; Cua et al., 2006; Shah and Ward., 2003; Kannan and Tan., 2005; Swink et al., 2005).

Shad and ward (2003) has showed in the article than lean concept has been linked to operational performances always. Narasimhan and Das (2001) explored that in terms of competitive priorities of the strategies the concept of operational performance has been conventionally characterized. This concept of competitive priorities was first introduced by Hayes and Wheelwright (cited by Lewis 2000) as the strategic preferences or dimensions where an organization select to compete. Hence, strategic alignment on manufacturing capabilities and competitive priorities is important in order to achieve competitive advantage. (Hu et al. 2002).

Karlsson and Ahlstrom (2006) illustrated that inventory as one of a main waste in the eight types of waste categories in lean concept has impact on reducing set up time as an operational performance. JIT as another main tool in the lean manufacturing concept has simplified production processes as an operational performance. (Kannan and Tan, 2005).

Pull-production systems are highly supported by JIT techniques (So and Sun 2010) such as controlled material flow and the production of small lot sizes, which allow manufacturing to synchronize production with the demand rate (Kannan and Tan 2005; Jayaram et al. 2008).

Since many scholars have tested and proved the effective use of lean manufacturing practices on the impact of operational performances. (Flynn et al. 2005; Shah and Ward 2003; Kannan and Tan 2005; Swink et al. 2005).

The contradiction to the above relationships also been highlighted in the literature. (Callen et al. 2000). Previous studies have used operational performance as an aggregate construct, which have ignored on its individual components, and has not taken the dimension of operational performances. Since operational performances has not been analyzed as a multidimensional entity the results have been shown as negative on the relationship between lean manufacturing and operational performances. Since the studies has not focused on different dimension on operational performances such as delivery, cost, quality the aggregate concept has given a negative impact on the relationship been disregarded with some important individual components. There are a few empirical studies that have analyzed the link between internal lean practices and multiple operational performance dimensions. (Fullerton and McWatters, 2001; Ketokivi and Schroeder, 2004). However, the result has shown contradiction in nature with the use of single measures for both the variables which have not captured the constructs accurately.

## 6. Conclusions

This study makes important contributions to the manufacturing organizations literature in terms of providing a more fine-grained understanding of the impact of lean manufacturing practices on operational performances in the apparel sector in Sri Lanka. This study has filled the theoretical and empirical gap identified in the problem statement.

This study achieved the objectives of measuring the relationship between lean manufacturing practices and operational performances in the apparel sector in Sri Lanka

The research question posed in the study were answered with the study: what is the current context of the impact of lean manufacturing on operational performances in the apparel sector in Sri Lanka?

To achieve better operational performances the mechanism by which learning is acquired and transmitted to the next level is very important, and the first recommendation is that in an organization, this process needs to be carried out in a very systematic way, (From manager level to middle manager level to operator level) one that enhances mutual understanding among employees which needs to be incorporate to the strategic level planning of the organization.

Secondly, Sri Lankan apparel organizations are more geared towards achieving targets, while retaining new knowledge or implementing a system is taken as a secondary responsibility. With firefighting as the current common feature of many organizations in the apparel sector, the probability of retaining and improving on new practices is limited, and the second recommendation is that organizations should improve in this area.

Thirdly, most decision making parties in an organizations need more training and awareness of this type of new knowledge bases which should be practices that are carried out simultaneously with their day to day work in the apparel sector. Motivating employees towards achieving goals and encouraging team collaboration is a direct responsibility of these parties. Lower level employees should be able to watch the behaviors and attitudes of higher level employees, and if these behaviors are proactive and efficient, they will automatically change the organizational setting in a positive direction.

It is also recommended that problem solving should be considered as the primary way in which to improve operational performance, and this should be practiced in a practical context. Each problem can be taken as a new learning experience, and thus, organizational learning will lead to the achievement of better results.

### 6.1 Managerial Implications

With the increasing demand on lean manufacturing practices in the Sri Lankan apparel sector assessment on these fields have become key in both academic and in the industries.

The practices of lean should be implemented and continued with an effective purpose which will bring the required operational performances to an organization. It is evident from the findings that lean manufacturing practices should be considered as new knowledge bases to an organization which will result in long term benefits with that consideration. Since the concept have been generated from Japan when it is adopted to Sri Lankan context accepting them as new knowledge will bring more results together.

The implementation of the lean manufacturing practices need to focus on long term benefits which need to be taken as a part of the job of ever body in the organization which will then bring a positive association with the operational performances, this knowledge bases should be embedded to the systems for a long term which is culturally significant. Hence lean manufacturing practices are to be embedded to the cultural values of the organization which will lead on achieving better results. Once it is culturally embedded it will enhance the mutual trust and understanding of people and will encourage achieving operational performances.

### 6.2 Theoretical Implications

The study provides inferences made from an instrument that is valid and reliable for the current study‘s context for evaluating the impact lean manufacturing practices on operational performances.

Further, the study provides a research framework that identifies significant relationships between impact lean and manufacturing practices operational performances. This framework provides a foundation and insight for future researchers in the area of operations management. This new model that brings novelty in this study captures very important relationships among the four variables specifically with the mediating impact.

The new instrument shall provide better guideline for researchers in operations management area, and thus, can be considered as a strategic management tool. The study has converted the unobservable variables to observable level which can be used by any researcher.

### 6.3 Limitations of the Study

Although this research makes significant contributions from both theoretical and practical points of view, it also has some limitations, which are described below.

An examination of those limitations will assist future researchers to work around them.

Due to the limited number of observations collected through the survey questionnaire, data was limited to the area tested, and therefore, the results may not be generalizable to other contexts. New mailing lists and research methods can be used to improve the response rate.

The impact of lean manufacturing practices on operational performances in the long run was not captured, since this was a cross sectional study, and done only during a short period of time.

In this research, single managers were taken as the respondents to answer items related to each dimension. Taking only a single respondent into consideration may not cover all the perspectives. Therefore, the use of a single respondent may have generated some measurement inaccuracies.

### 6.4 Directions for Future Researches

Directions for future research based upon the limitations discussed above and careful considerations of the research potentials.

First, future research should apply multiple methods of obtaining data. The use of single respondent to represent what are supposed to be intra/interorganization wide variables may generate some inaccuracy, more than the usual amount of random error (Koufteros 1995). Future research should seek to utilize multiple respondents from each participating organization in an effort to enhance reliability of research findings.

Second, future research should consider other relevant factors not considered in this research such as mediating and moderating variables; organizational survival, learning orientation etc. Adding more performance measures for the operational performances would further enhance the future outcomes.

Thirdly, future research can be carried out with developing hypothesis on some specific lean manufacturing dimensions, and operational performances rather taking the total construct as a whole.

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