

Perception on Lean Practices in a Lean Implementation

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DOI: 10.6007/IJARBS/v3-i11/375 URL: <http://dx.doi.org/10.6007/IJARBS/v3-i11/375>

ABSTRACT

In today's highly competitive world where most businesses focus on cost and quality, organizations with efficient and effective supply chains are able to stand out with inherent competitive advantages. To achieve this many organizations adopt lean practices which fundamentally stress on the elimination of non-value added tasks (such as unwanted transportation, extra processing, excess motion, repairs on defects, over production, excess inventory and incidents of waiting or delays). Nevertheless, the introduction of lean practices in any organization is often accompanied by changes in the working environment. These changes influence the people working there. This study looks into the perceptions of the workers, in a case study site (a Japanese Multi-National Corporation situated in Penang, Malaysia producing semi-conductor devices), on the lean practices implemented in the internal supply chains. The study compared the perceptions using a self-administered questionnaire. Perceptions of those highly exposed to lean practices were compared against the perceptions of those with low exposure. A significant difference, in the perceptions of those who had high exposures to lean practices as compared to those with low exposures pertaining to the internal supply chain performances, was found. The perceptions obtained proved useful as empirical studies showed negative implications such as the deteriorations in employee emotions, attitudes, behaviors, commitments and turnovers. Moreover, the perceptions of the employees and the employers also did not match. Useful recommendations have been put forth which could be used for improving the internal supply chain performances of other organizations. The recommendations encompass areas such as resource allocations, mind-set changes, trainings, personnel and lean practice implementation strategies.

Keywords: Lean Practices, Internal Supply Chain Performance, Lean Manufacturing

1. Introduction

In today's level of unprecedented global competition, companies must stay competitive through improved manufacturing operations. To do so, the organizations need use its resources (such as human, machines etc) efficiently and effectively, which in literature is commonly known as lean manufacturing. Apart from this the organization need to not only use existing resources more efficiently, but creatively (Ahmed, 2009). Lean manufacturing (applying lean practices) has been used to improve the operational performance through eliminating waste or

“muda” (in Japanese) where waste is anything other than the minimum amount of equipment, material, parts and working time, which are absolutely vital to production. The focal point of lean manufacturing is cost reduction through the elimination of waste, thereby improving profitability (Lynch, 2005). Despite wide knowledge and resources, many companies are struggling to become or stay lean (Taj & Morosan, 2011). As such companies need to evaluate or assess their current state of operations to see if the mutual beliefs, perceptions and informal obligations between the stakeholders are aligned or otherwise (Kickul, Scott & Belgio, 2004). Being aligned will give the organization a significant source of competitive advantage (Clutterbuck, 2005) in contrast to the negative effect of not being aligned. In fact empirical studies have shown the downward adjustments in various employee emotions, attitudes and behaviours, including organizational commitment (Lester, Turnley, Bloodgood & Bolino, 2002), increased turnover (Maertz & Griffeth, 2004), and increased deviant behaviors (Kickul, 2001) when there is misalignment.

Starting from the 90’s, many companies tried to transform their conventional manufacturing line into lean manufacturing by either transforming their entire processes or by creating new cellular production systems (Liker, 1997; Womack & Jones, 1996). Lean manufacturing is much more than a technique, rather it is a new way of thinking and a holistic system approach that create a culture in which everyone in the organization continuously improves the operations (Liker & Franz, 2011; Liker, 2004). This way of thinking has its origin in the work that was originally undertaken to understand the phenomenal success of Japanese industry then, primarily in the automotive sector and specifically in Toyota (Womack, Jones & Roos, 1990). The Toyota approach is famously known as Toyota Production System (TPS) with an interesting history. Kiichiro Toyoda, the founder of Toyota Automotive Industries and Taiichi Ohno who was a member of his staff (Shingo, 1989), was credited with the creation of TPS which became lean manufacturing (Holweg, 2007). This lean manufacturing approach is very much the dominant paradigm in many writings related to the area of supply chain performance (Cox, 1999).

2. Research Objectives

The objectives for this research are summarized as below.

1. To investigate the effect of Lean Practices on employees’ perception of Internal Supply Chain performance.
 - a. To investigate the effect of Cellular Layout on employees’ perception of Internal Supply Chain Performance
 - b. To investigate the effect of 5S on employees’ perception of Internal Supply Chain Performance
 - c. To investigate the effect of Visual Management on employees’ perception of Internal Supply Chain Performance
 - d. To investigate the effect of Teams on employees’ perception of Internal Supply Chain Performance
 - e. To investigate the effect of Lean Organizational Structure on employees’ perception of Internal Supply Chain Performance

2. To investigate the relationship between Lean Practices and Internal Supply Chain Performance.
3. To investigate the difference in perception of Internal Supply Chain Performance in terms of:
 - a. gender
 - b. job function
 - c. length of service
 - d. section
 - e. race
 - f. educational level

3. Methodology

3.1 Research Design

This research is a quantitative one, wherein it attempt to measure the perception of the population in the selected site. The population is grouped into two groups, namely one being those exposed to Lean Practices or in a Lean Implementation while the other consist of those who are not exposed. It will measure the perception of these two groups through a survey using self administered questionnaires which is adapted from Li (2002) and Qrunfleh (2011). The design of this research is one that is descriptive (which in a normal situation the subjects are measured once) and at the final analysis would attempt to establish associations between the targeted variables (Zikmund, 2003; Diebold, 2007).

In order to evaluate the appropriate method to adopt, consideration is given to the time frame of this project, cost of obtaining the data, the availability of the data etc. This research project is a single case study of which the research methodology relies on multiple sources of evidence so as to add to the breadth and depth of data collection. Such single case studies can be seen in numerous research such as the one carried out in Northeastern United States of America on the subject of how a manufacturing plant perform in its integrated industrial supply chain (Elmuti *et al.*, 2008). To assist in bringing forth richness of data together, triangulation would be carried out so as to contribute to the validity of the research (Yin, 2003). In the final compilation of the research findings, this approach will enable the combination of a variety of information sources, including documentation, interviews etc.

A cross-sectional survey was carried out to gather data at a single point in time, so as to answer the study's research questions. Survey is a common method and one that could easily be understood and accepted by the population in general. This is because most people have been exposed to a survey at one time or another (Zikmund, 2003). Furthermore a survey method was employed because this study strongly believes that survey research is best adapted to obtain personal and social facts, beliefs, and attitudes (Kerlinger, 1973).

3.2 Population and Respondents

3.2.1 Population

The population of this study is made up of indirect employees (in contrast to the direct employees who are doing the actual physical operation of the organization) of the case study site. They consist of the personnel in the managerial functions (directors, production managers, quality assurance managers, maintenance manager and planning managers), engineering functions (process engineers, quality assurance engineers, maintenance engineers) and operational functions (production supervisors, quality assurance supervisors and maintenance supervisors). The size of this target population as at the point of this research stands at 341 with the breakdown as in Table 3.1.

Table 3.1

Population in Case Study Site

	Head count	%
Operation	96	28%
Engineering	202	59%
Management	43	13%
Total	341	100%

The main bulk of the population are those under the engineering function (59%) followed by those in operation (28%) and lastly those in the managerial function (13%).

3.2.2 Respondents

This study attempts to obtain the responds from the population instead of doing a sampling as the researcher has the ability and resource to collect data from the entire population (Saunders *et al.*, 2003). After having informed the various department heads of this research (through face to face explanation), the researcher managed to send out the questionnaire along with the cover letter, to all the population as shown in Table 3.1 earlier (less by 23 who were selected for the pilot test). Though not all responded, the response has nevertheless being very encouraging. A total of 190 responses were received of which 4 were rejected for reasons such as incomplete answering and illogical entry (example – double tick). As such 186 (58% response rate) responses were accepted and used for analysis. In all the time frame taken from the onset of questionnaire distribution till the acceptance of the responses took about 2 months. Details of the respondents are shown in Table 3.2.

Table 3.2

Respondents in the Case Study Site

	Head count	Questionnaire sent out	Accepted Responses	Response Rate
Operation	96	93	51	55%
Engineering	202	186	97	52%
Management	43	39	38	97%

3.3 Method of measurement

Apart from the demographic factors, all other variables included in this study were measured using multiple items drawn from previous research. However phrasings of the items were modified to suit the sample and local setting.

In order to ensure consistency among variables and to avoid confusion among respondents, all the items were measured using the Likert-style rating scale (Saunders *et al.*, 2003). A scale of 1 to 5 was used to measure the degree of agreement or disagreement pertaining to the specific questions asked. This scale consist of “1” being “Strongly Disagree”, “2” being “Disagree”, “3” being “Neutral”, “4” being Agree and “5” being “Strongly Agree”.

3.4 Data Analysis Technique

All data were compiled and analyzed using Statistical Packages for the Social Sciences (SPSS) version 17.0. For all analysis discussed, a significance level of 0.05 was used. A p value less than 0.05 indicates the rejection of the null hypothesis and a p value more than 0.05 indicates acceptance of null hypothesis. Descriptive statistical analysis was carried out to determine group statistics for the sample which covers mean value, standard deviation and standard error of mean. As the study involves comparison of groups, independent t-test will be carried out for groups of two while comparison of groups more than two the analysis of variance (ANOVA) were used for inferential statistical analysis (Coakes *et al.*, 2010; Lay & Khoo, 2009)

3.5 Pilot Study

Before embarking on a mass survey, the researcher conducted a pilot study for the self-administered questionnaire. This is to assess the understanding of the respondents pertaining to the questions asked in the survey. Apart from assessing the clarity of questions it also provides feedback on the appropriateness of the response categories, adequacy of instructions, effectiveness of data capturing and also enable the editing of fields where deemed necessary. The pilot study also entails interviews so as to obtain feedbacks or recommendations through face-to-face encounter. From the pilot study result it also enable a mock-up of data output.

3.6 Reliability and Validity

Based on the pilot study response of the self-administered questionnaire, the researcher did a reliability analysis to verify whether it is acceptable. This exercise is an assessment of the degree of consistency (internal consistency) between multiple measurements of a variable (Hair *et al.*, 2006). Reliability analysis is done by obtaining the Cronbach's alpha coefficient (which refers to the degree to which items in set are homogeneous). A value of 0.6 to 0.7 is considered as the lower limit of acceptability and a value of 0.7 to 0.8 would be desired of which certain variables may need to be excluded or reviewed if its Cronbach's alpha is not within this limit (Hair *et al.*, 2006; Coakes *et al.*, 2010).

Reliability statistic analysis for this research pilot study is summarized as in the Table 3.3 below.

Based on the the Cronbach's Alpha value of 0.94 the result of the analysis should be accepted (Hair *et al.*, 2006).

Table 3.3

Reliability Test - Cronbach's Alpha

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.940	.941	60

4. RESULTS AND DISCUSSION

4.1 Results

The data obtained from the research conducted through the self-administered questionnaire in the case study site was compiled and analyzed (survey period lasted about two months). 186 accepted responses were used.

4.1.1 Demographics of Study

The demographic of the case study site was tabulated through keying in each and every accepted response into the SPSS software. Table 4.1 shows the summary of the demographic characteristics.

Table 4.1

Demographic Characteristics

Category	Details	Frequency	Percent	Valid Percent	Cumulative Percent
Job Function	Operation	51	27.4	27.4	27.4
	Engineering	97	52.2	52.2	79.6
	Management	38	20.4	20.4	100.0
Education Level	Non Tertiary	78	41.9	41.9	41.9
	Tertiary	108	58.1	58.1	100.0
Age	21~30	71	38.2	38.2	38.2
	31~40	31	16.7	16.7	54.8
	>41	84	45.2	45.2	100.0
Years in Service	<2	46	24.7	24.7	24.7
	2~5	26	14.0	14.0	38.7
	6~10	12	6.5	6.5	45.2
	>10	102	54.8	54.8	100.0
Gender	Male	118	63.4	63.4	63.4
	Female	68	36.6	36.6	100.0
Race	Malay	44	23.7	23.7	23.7
	Chinese	116	62.4	62.4	86.0
	Indian	24	12.9	12.9	98.9
	Others	2	1.1	1.1	100.0

Vital information about the respondents as it relates to the study can be derived from the collective profiles. The population consist mostly of Engineers (52.2%) followed by those who

are in Operation such as Production Supervisors (27.4%). Management group who oversee the various aspect of the organization comprise 20.4%. These are by category of their job functions.

In term of their education level it was found that majority (58.1%) have tertiary education. It was specifically stated that tertiary education level refers to those who have obtained a Bachelor, Master or a Doctoral qualification. As for the other 41.9% who are classified as non-tertiary, they are those who have High School, Diploma or a Certificate qualification.

As age is a sensitive matter to some, the researcher did not request for the absolute age but rather provides an age range for the individuals to respond. Nevertheless based on the respond it can be seen that the population in this case study site can be considered an aging population. This is because 45.2% are those who are above the age of 41. The next groups in term of size are those who are considered young. Their age falls in the region of 21~30 years old. Sandwich in between are those who falls in between these two groups.

As also reflected in the age, the population comprise of many who are long service members. In fact 54.8% are found to have served the company for more than 10 years. Apart from these the new employees (those with less than two years of service) form a considerable size (24.7%). In term of gender, more than half are male (63.4%). Female populations comprise 36.6% of the total population. For the racial breakdown of the said population, it consist of Chinese (62.4%); Malay (23.7%), Indian (12.9%) and others (1.1%). There are 3 respondents who are classified as "others". These are those who are from the minority Thai group.

4.1.2 Hypotheses Testing

For the cases where the hypotheses refers to the comparison of 2 groups the independent sample t-test was chosen while those comparing between groups greater than 2 will be analyzed using Analysis of Variance (Zikmund, 2003; Gay & Airasian, 2003, Coakes *et al.*, 2010).

Summary of Hypotheses

Summary of the hypotheses tested is tabulated as in Table 4.2.

Table 4.2

Summary of Hypotheses

Hypotheses	Accept / Reject
H ₁ 1 : There is a significant difference in employees' perceptions of Internal Supply Chain Performance between those with high exposure to Lean Practices and those with low exposure	Accept
H ₁ 1a : Between those with high exposure to Lean Practices and those with low exposure, there is a significant difference in employees' perception of Internal Supply Chain	Accept

Performance with respect to Cellular Layout

H ₁ 1 _b : Between those with high exposure to Lean Practices and those with low exposure, there is a significant difference in employees' perception of Internal Supply Chain Performance with respect to 5S practiced	Accept
H ₁ 1 _c : Between those with high exposure to Lean Practices and those with low exposure, there is a significant difference in employees' perception of Internal Supply Chain Performance with respect Visual Management.	Accept
H ₁ 1 _d : Between those with high exposure to Lean Practices and those with low exposure, there is a significant difference in employees' perception of Internal Supply Chain Performance with respect to Teams	Accept
H ₁ 1 _e : Between those with high exposure to Lean Practices and those with low exposure, there is a significant difference in employees' perception of Internal Supply Chain Performance with respect to Lean Organizational Structure.	Accept
H ₁ 2 : There is a significant correlation between Lean Practices and Internal Supply Chain Performance	Accept
H ₁ 3 _a : There is a significant difference in employees' perceptions of Internal Supply Chain Performance in terms of gender	Reject
H ₁ 3 _b : There is a significant difference in employees' perceptions of Internal Supply Chain Performance in terms of job function	Reject
H ₁ 3 _c : There is a significant difference in employees' perceptions of Internal Supply Chain Performance in terms of length of service	Reject
H ₁ 3 _d : There is a significant difference in employees' perceptions of Internal Supply Chain Performance in terms of section	Accept
H ₁ 3 _e : There is a significant difference in employees' perceptions of Internal Supply Chain Performance in terms of race	Reject
H ₁ 3 _f : There is a significant difference in employees' perceptions of Internal Supply Chain Performance in terms of educational level	Reject

4.3 Discussion

4.3.1 Does Lean Practices have a Significant Effect on Employees' Perceptions of Internal Supply Chain Performance?

The answer to whether lean practices have a significant effect on employees' perception of Internal Supply Chain Performance is affirmative. As the result from the survey carried out (self-administered questionnaire) shows, the first hypothesis related to the research questions was accepted. It was thus concluded within the scope of the case study site that there is a significant difference in employees' perceptions of Internal Supply Chain Performance between those with high exposure to Lean Practices and those with low exposure. The average mean for these two groups are 3.623 and 2.770 respectively.

The greater mean for those with high exposure to lean practices would likely be attributed to the fact that the respondents sees the positive effect of lean practices and associating it with the improved internal supply chain performance. Furthermore the various test using independent sample t-test and ANOVA shows that the responses received were independent of their demographics details.

There is however statistically a significant difference in the perception of the respondents with regard to the internal supply chain performance when analyzed from the angle of which section they work in. It was found that those who works in Section 1 shows a higher mean (3.711) compared to those from Section 2 (3.533). This result conveys the message that the area a person works in influence their perception significantly.

Through conducting interviews and facts compiled from documents in the said site the researcher was able to summarize them to show the effect before and after lean practices implementation.

4.3.2 Does the Implementation of Cellular Layout have a Significant Effect on Employees' Perception of Internal Supply Chain Performance?

Cellular layout is generally a common practice in areas where lean is implemented. The result did show a significant difference in the perception of those who have high exposure to lean practices compared to those with low. It could be that the respondents sees numerous cases of how the cellular layout made a difference (as described in the cases earlier on) in the operation area that they perceived it to be effective in improving the internal supply chain performance. At the site feedbacks from respondents through interviews reveals various positive effects of cellular layout.

Just as the perception of the respondents are significant for this case study site other studies also did concurs with it, such as the effect of the physical flow improvement due to layout change from process layout to cellular layout by Cagliano et. al. (2006). It is also

appropriate to mention that research on best practices in manufacturing to achieve supply chain flexibility using layout strategy (though not necessarily cellular layout) has been acknowledged (Boyle, 2006).

4.3.3. Does the Practice of 5S have a Significant Effect on Employees' Perception of Internal Supply Chain Performance?

Good housekeeping makes good business sense. The overall productivity of a workplace can be substantially affected by good housekeeping but often time this important aspect is given low priority. Apart from improving productivity (which results in improved internal supply chain performance), good housekeeping reassures customers and potential customers that their products are being taken care of (Cohan, 1985). The result in this research concurs with such findings as can be seen by the significant difference in perception of those who have a high exposure to lean practices compared to those with low exposure. Support for practice of 5S having a positive effect on the internal supply chain of a lean implementation was advocated in researches done in various places apart from Japan (where it is widely practiced (Gapp *et al.*, 2008) such as in Mexico in some latest research (Manuel & Juan, 2012), Spain (Alberto, Alejandro & Javier, 2010). A dissertation work in USA on 5S also showed how 5S was correlated to productivity, Cycle Time (or TAT) and quality improvement in the electrical industry (Lynch, 2005).

4.3.4. Does the Use of Visual Management have a Significant Effect on Employees' Perception of Internal Supply Chain Performance?

Visual Management – much related to 5S the practice of visual management is concerned with ensuring visibility. When there is a problem it must be quickly and easily seen by all parties.

From the result of the survey done it was seen that there is a significant difference in the perception on internal supply chain performance for those who are having a high exposure to lean practices compared to those who have low exposure. This result agrees with studies done in other industries such as automotive where the use of visual management is very evident (Ranky, 2007). The result concurs with the view by other research which points to the fundamental of using Visual Management so as to highlight issues or problems. This was illustrated by using what was called the “Japanese sea” model (Yamamoto & Bellgran, 2010).

4.3.5. Does Teams have a Significant Effect on Employees' Perception of Internal Supply Chain Performance?

Though the whole population of the site surveyed practice teams in the organization, there is a significant difference in the perception of those who are having a high exposure to lean practices compared to those who are having a low exposure. Basically the respondents with high exposure to lean practices perceived the effect of teams on a more positive note in term of

the effect on internal supply chain performance compared to those with low exposure. Research has shown the positive effect of teams such as improvement in productivity (Fullerton & Wempe, 2009), communication (Bhupathiraju 2008) and generation ideas (Hashim, 2005; Duhe, 2008). Teams encourage participation in improvements through systems for workers suggestions (Olivella *et al.*, 2008). This study concurs with such views and though difficult to generalize it shows that employees in teams with high exposure to lean practices are even more positively inclined in their perception of the effect of teams on internal supply chain performance compared to those with low exposure.

4.3.6 Does Lean Organizational Structure Practiced have a Significant Effect on Employees' Perception of Internal Supply Chain Performance?

It cannot be denied that organization structure influence the performance of an organization (Inocencia & Jose, 2011). With lean implementation changes in organizational structure slowly but surely evolve. Organizations become flatter as described by Patrickson (1994) and Worley (2004). By a flatter organization it is expected that communication flow would improve in term of accuracy and speed (Heizer & Render, 2001; Alavi, 2003; Olivella *et al.*, 2008). The result of the survey shows that those with high exposure to lean practices have a higher mean in terms of their perception on internal supply chain performance compared to those with low exposure. The difference is significant.

4.3.7 Is there a Significant Correlation between Lean Practices and Internal Supply Chain Performance?

Based on the result of the Pearson Correlation between Lean Practices and Internal Supply Chain Performance there is a strong correlation between these two variables.

One of the important results from the analysis of this study is that there is a strong evidence that the implementation of lean practices have a significant effect on the internal supply chain performance. This adds on to the body of knowledge of yet another case showing the positive aspect of lean implementation.

4.3.8 Is there a Significant Difference in Employees' Perception of Internal Supply Chain Performance in Terms of Gender, Job Function, Age, Length of Service, Sections, Race and Level of Education

From the standpoint of gender, job function, length of service, race and educational level the result shows that there is no significant difference in the perception of internal supply chain performance. Nevertheless, from the aspect of the section they work in there is a significant difference. In fact those in Section 1 shows a higher mean compared to those in Section 2. Section 1 is one area where the management has thus far focused their lean implementation while Section 2 will be in the pipeline pending a review of how well the former has been doing.

It can thus be said that the perception of the employees' of the internal supply chain performance is influenced by which section they work in and not by other demographic characteristics such as gender, job function, age, length of service, race and educational level.

5. Conclusion

This study on the effect of lean practices on the perception of internal supply chain performance has contributed in several ways to the existing literature.

- a. It identified key lean practices within the scope of a case study site in Malaysia and measured the perception of the respondents within that population.
- b. Though lean practices are widely researched, the number of studies in Malaysia is rather few in comparison. As such this adds to the literature on this subject.
- c. Limitations in this study are also highlighted, explaining why generalization in this situation is rather difficult as the responses are contingent upon the environment of the case study site.
- d. The findings highlighted the importance of studying organizational phenomenon within real-world settings (Worley & Doolen, 2006) and to take into consideration the contingency factors as the success of lean practices is contingent upon the scenario of the site implementing it. This is also what the contingency theory claim.

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