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Relationship between organisational change and lean manufacturing implementation in Malaysian automotive industry

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Abstract: *Lean manufacturing is a proven approach for success in manufacturing industry. However, several organisations failed in their attempt to implement lean manufacturing. The transformation to lean manufacturing system requires radical change which involves total reshaping of purpose, system and culture of the organisation. This paper presents an investigation on the influence of organisational change to the lean manufacturing transformation. The survey was completed by 60 firms in the Malaysian automotive industry. The respondents were chosen from those who involved directly with lean manufacturing practices such as production and quality personnel. The survey findings show that organisational change factors such as change readiness, team development, leadership and management support, effective communication, employee training, employees' empowerment and review process have significant influence on lean manufacturing implementation. Furthermore, there were also significant differences that exist between organisational change in companies which categorised as non lean, in-transition and lean firms.*

Keywords*: Lean manufacturing, organisational change, automotive industry*

1. INTRODUCTION

Heightening challenges in today's global competition have prompted many manufacturing firms to adopt new manufacturing management strategies in order to improve the firms' efficiency and competitiveness. Lean manufacturing (LM) as a management tool has taken manufacturing firms by storm and many have adopted lean techniques in many different forms and names.

Now, LM has become a widely accepted and adopted best manufacturing practice across countries and industries (Holweg, 2007). The ultimate goal of a lean organisation is to create a smooth and high quality organisation that is able to produce finished products concerning customers demand in the quality looked-for with no waste. However, in reality, not many companies are able to transform to LM. The LM transformation is filled with formidable challenges. Most particular are to understand the real essence of LM concept and philosophy (Balle, 2005), and also to deal with the cultural differences issues either national or organisational (Fairris and Tohyama, 2002; Herron and Braiden, 2007; Liker and Hoseus, 2008; Wong, 2007).

The purpose of this paper is to investigate the lean manufacturing implementation in Malaysian automotive industry. In the light of this, it is important to determine the impact of organisational change to successful lean implementation.

2. LITERATURE REVIEW

Lean manufacturing is a manufacturing strategy that aimed to achieve smooth production flow by eliminating waste and increase the activities value. Some analysts even point out that if an organisation ignores the lean manufacturing strategy, the company would not be able to stand a chance against the current global competition for higher quality, faster delivery and lower costs (Flott, 2002; Srinivasaraghavan and Allada, 2006). In a large cross-country analysis done by Oliver et al. (1996) proved that lean manufacturing principles could produce high performance firms.

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The change from traditional manufacturing system to lean manufacturing is not an easy task. Achanga et al (2006) suggest that the success of lean manufacturing implementation depends on four critical factors: leadership and management; finance; skills and expertise; and supportive organisational culture of the organisation. Some researchers suggest that application of full set of lean principles and tools also contribute to the successful lean manufacturing transformation (Herron and Braiden, 2007; James, 2006).

Today, change is not an exception but a steady going process. Changes require attention to the impact on both process and people. The practice of organisational change management focuses on ensuring that the people side of change is address properly aligned with business strategy, technology and business process (Kimberly, 2002). Jones (2007) defines organisational change as the process by which organisations move from their present state to some desired state to increase their effectiveness.

Lean manufacturing represent a holistic approach to change. Multiple initiatives are established in order to foster a culture of continuous improvement. In order to create the foundation for lean manufacturing to take hold, a significant organisational and culture change must occur within the organisation. The support and commitment from top management are significant in ensuring the success and sustainability of lean manufacturing (Crute et al., 2003; Lee-Mortimer, 2008; Motwani, 2003). Other important factors are dedication of employees towards lean manufacturing initiatives, and education or training. The workforce empowerment could only be achieved through appropriate training on concept and basic principles, and also reasons of lean manufacturing (Crute et al., 2003; Lee-Mortimer, 2008). As people are the soul of lean process, having the right perspective and attitude towards lean manufacturing is crucial to the success of lean transformation (Achanga et al., 2006; Balle, 2005).

A case study on two successful companies in sustaining change towards lean manufacturing by Papadopoulou and Ozbayrak (2005) found that management commitment, communication, workforce empowerment and ownership improvement through a methodical lean education system and encouragement, and development of lean culture are essential for sustaining change towards leanness. This support the study done by Boyer (1996) that investment in manufacturing infrastructure such as quality leadership, group problem solving, training and worker empowerment is the critical stepping stones towards successful lean manufacturing.

Organisational side of change is relate to the design and structural issues of systemic and long-term change efforts, while evaluation of change effort involved in indicators of a change effort's effectiveness. In order to successfully managing change process, Huq (2005) suggested six change management issues that need attention; leadership/management issues, implementation of change and control, barriers to change, communications, people culture factor, and change review. These issues represent the change dimension set for successful implementation. Whereas, Paton et al. (2008) discovered some core themes that recur through many literature in achieving organisational change; change readiness, planning, leadership, management and support, effective communication, recognition and response to resistance, evaluation and learning, and people. It is important to understand the organisational change issues as related to lean manufacturing. Transformation to lean manufacturing system can fail if the relationship between organisation change and cultural change is not fully understood. To stay competitive in today's global manufacturing environment, companies must develop a cultural change process and plan that support lean manufacturing deployment.

3. RESEARCH METHODOLOGY

A questionnaire was developed to collect data for this research. In order to achieve the objectives of the study, the Malaysian automotive manufacturing firms were selected as the population of this study. The database was obtained from 2008 Federation of Malaysian Manufacturers (FMM) and SMIDEC directories. The list involved automotive industry that consists of electrical, electronic, metal, plastic, rubber and other parts or components. The manufacturing firms involved in the research strategy are those from medium and big companies, with more than 50 employees. The decision is based upon previous studies which show that small manufacturing firms are less likely to implement LM concepts due to certain limitations and barriers such as capable leadership, knowledgeable workforce, financial support and adequate training (Bonavia and Marin, 2006; Perez and Sanchez, 2000; Shah and Ward, 2003, 2007). The personnel involved in the survey are those from managing directors, manufacturing/production managers and executives, and also quality managers and executives.

The questionnaire consists of four parts. The questions included the following areas,; background information of the organisation, lean manufacturing implementation, organisational change factors, and respondent information. The items for "lean manufacturing implementation" were generated from Shah and Ward (2003) to identify the extent of LM implementation within Malaysian automotive industry. The questions are set up on a five-point Likert scale to measure the extent of implementation of the practices described by each of the items. The scale ranged from none (1) to complete implementation (5). Intermediate scale values were referenced to little implementation (2), some implementation (3), and extensive implementation (4). A prime consideration in design

of the survey instrument was keeping it short and focused in order to obtain an adequate response rate.

In addition to questions on lean practice area, seven questions on perception of organisational change efforts were produced. Organisational change effort can be defined as the extent of the company's organisational change effort and impact in implementing lean manufacturing. In this study, the organisational change effort was measured by change readiness, leadership and management support, team development, change agent system, effective communication, training, rewards system and lean review. These items were generated from from Carnall (1991), Boyer (1996), Nesan and Holt (2002), Herkness (2005), Herron and Hicks (2007), Mohanty and Yadav (1996), Smith et al. (2003), Dahlgaard and Dahlgaard-Park (2006), and Pollit (2006). In this section, five-point Likert scale is used to measure the extent of agreement and emphasis of the effort in their respective companies. The scale range consists of 5 points from strongly disagree (1), disagree (2), somewhat agree (3) agree (4), and strongly agree (5).

The process of developing the questionnaire also included a pilot survey, which was used to modify and eliminate the number of variables. Experts of the subjects were consulted. The comments and feedback were analysed and a few minor modification were made especially in questionnaire format. Majority of the feedback from the experts gave positive remarks and acceptable for data collection. Although no new items were added for the data collection phase, many items were reworded or modified. The questionnaire was then ready for data collection. In the case of reliability test, Cronbach's alpha was employed to measure the internal consistency of the research instrument. All the results proved high internal consistency with coefficient alpha ≥ 0.70 and therefore the instrument is reliable.

4. RESULTS AND DISCUSSION

The initial email was sent to 150 target respondents. Of the original emails, 17 emails could not be delivered either the email address was wrong or the person has left the company. The follow-up email was sent a week later to remind the respondent who has not yet responded and thank you for those who have already returned their questionnaire. A total 19 responses were returned, 11 of them were online survey and the remaining seven were sent through email. This actually gave quite a low response rate of 12.7%. However, the authors were unhappy with the initial response rate and seek other method of sending questionnaire through postal mail. As a result of this, the number of responses rose to 60 and consequently improved the response rate to 40%.

4.1 Company Background

The first aspect to be investigated was the general background of the companies involved. Table 1 shows the general background of the companies such as types of product produced, company age, company ownership and company size (based on the number of employees).

Table 1: General background of the company involved in the study (N = 60)

	n	%
Types of product produced		
Assembly	10	16.7
Plastic parts	11	18.3
Metal parts	27	45.0
Electronic parts	9	15.0
Electrical parts	9	15.0
Rubber parts	2	3.3
Company age (year)		
New (<10)	8	13.6
Intermediate (11-20)	26	44.1
Old (>20)	25	42.4
Company ownership		
100% local	30	50.0
100% foreign	8	13.3
Joint venture	22	36.7
Company size (no. of employee)		
Medium (151-250)	14	23.3
Large (> 251)	46	76.7

As shown in Table 1, the respondents' companies were mostly manufacturing metal parts for automotive industry (45.0%). Meanwhile, 18.3% of the companies are from automotive assemblers. Other types of product produced such as assembly, and electrical and electronic, are 16.7% and 15%, respectively. Majority of the companies are categorised as intermediate and old companies with 44.1% and 42.4% respectively. The intermediate company as defined in this study is the company that has been established between 11 to 20 years. Whereas, the old companies are those with more than 20 years of establishment. New companies which are less than 10 years are only 13.6%. Besides the company age, respondents were also asked about the size and ownership of the companies. As can been seen in Table 1, it shows that respondents were mostly of large companies with more than 250 full-time employees, which totalled 76.7%. In addition, half of the respondent companies are locally owned companies (50.0%). Whereas, 36.7% are joint venture and the remaining 13.3% are fully foreign owned.

Table 2: Mean values for three cluster analysis solutions for lean practices

	Non-lean (A)	**In-transition (B)**	**Lean (C)**	**ANOVA**	
	n=14	n=30	n=16	F	p-value
Process and equipment	2.81	3.50	4.27	57.36	.00
Manufacturing process and control	2.90	3.54	4.44	47.08	.00
Human resources	3.10	3.50	4.39	36.80	.00
Supplier relationship	2.47	3.25	4.05	57.54	.00
Customer relationship	2.74	3.47	4.35	36.51	.00

4.2 Lean Manufacturing Implementation

In order to identify the lean status of each respondent companies involved, cluster analysis was done to classify the companies into lean, non-lean and in-transition lean firm. Cluster means a group that is computed as the average values of the lean practices variables for all the firms and signifies the extent of the lean manufacturing implementation of that group. Companies were classified as being lean, in-transition or lean based on the hierarchical cluster analysis of their mean scores for each individual lean practice using the squared Euclidian distance between variables and Ward's method of optimizing the minimum variance between clusters. Table 2 shows the mean scores for the three cluster solutions.

As a result of the cluster analysis, the first group (A) had 14 firms and was characterised by low mean values for all five lean practices variables. This suggests that the firms forming this cluster implemented little lean manufacturing practices and categorised as non-lean firms. The second group (B) had 30 firms, and was characterised by moderate mean values for each of the five variables. This group is categorised as firms in-transition to lean manufacturing system. Finally, the third group (C), which had 17 firms, are classified as lean firms as it characterised by high mean values of each lean manufacturing practices variables. The values suggesting that these firms implemented lean manufacturing practices extensively in their organisation's operation and management.

The results in Table 2 also show one-way independent ANOVA to determine whether the difference between means for cluster non-lean (A), in-transition (B) and lean (C), are significant. The purpose of this test is to examine the cluster predictive validity and consistency with expected practice levels within groups. To test for homogeneity of variance, Levene test was used for equality of variances. The Levene's test showed that all lean practices are not significant ($p>0.05$) except for *Process and equipment*, which assumed the population variances for each group are relatively equal. To test whether the group means are the same is represented by the F-ratio. The results showed that all lean practices indicated $p<0.05$, which were significant, that stated the mean scores of lean manufacturing practices were different across the lean groups. This proved that the ANOVA results contributed to the evaluation of the validity of the cluster analysis.

In order to further verify the LM implementation in respondent companies, the tools implemented were also analysed based on the firm status of lean implementation (see Table 2). Non-lean firms had shown to emphasise more on *human resources* in lean tools implementation. Whereas, firms in-transition and lean firms spend more resources in *manufacturing process and control*. According to Herron and Braiden (2007), as the companies become stable and more knowledgeable in this field, more advanced lean tools were applied in order to support the end goal of the production system.

4.3 Organisational change management

In order to create the foundation for lean manufacturing to take hold, a significant organisational change must occur within the organisation. Correlation test was done to ensure the relationship exist between organisational change factors and lean implementation status. However, in this study, the data have violated parametric assumptions such as non-normally distributed data for organisational change factors. Hence, non-parametric statistics, Kendall's tau coefficient was used. As suggested by Field (2009), Kendall's tau should be used rather than Spearman's coefficient when small data set involved as Kendall's statistics is a better estimation of the correlation in the organisation.

Table 3 provides the correlations between each of the organisational change variables to lean implementation status. The results illustrate a significant positive relationships with lean status as most of them are significant at $p<.01$ except for Review System, which is significant at $p<.05$. However, Reward System does not shown to have any significant relationship with lean implementation status. Therefore, it is proven that, higher lean implementation status can be associated with higher organisational change factors except for reward system.

Table 3: Kendall's tau correlation coefficient of organisational change variables and lean implementation status

Organisational change factors	**Lean status (r)**
Change readiness: the management	0.394**
Change readiness: the employees	0.335**
Production team	0.464**
Leadership and management support: the top management	0.301**
Leadership and management support: the middle management	0.422**
Worker empowerment	0.438**
Effective communication	0.441**
Employee training	0.384**
Change agent system	0.354**
Reward system	0.109
Review process	0.211

Next, to further investigate the relationship of organisational change factors towards lean implementation, a test was done to look the differences of organisational change factors in three lean status groups. As the data violate the stringent assumptions of a one-way ANOVA, so the authors decided to perform a Kruskal-Wallis test. Table 4 shows result of Kruskal-Wallis test to compare the means of organisational change factors between non-lean, in-transition and lean companies. In order to conduct the test, the following hypothesis was set up

H_0: there are no significant differences between non-lean, in-transition and lean companies on the mean scores of organisational change factors.

H_1: there are significant differences between non-lean, in-transition and lean companies on the mean scores of organisational change factors.

In Kruskal-Wallis test, the test statistic that need to be reported are its degree of freedom and its significant. The findings in Table 4, indicate that all organisational change factors were significantly affected by lean status groups with $p<.05$ except for "Reward System". This finding indicates that there are differences of the mentioned organisational change effort in different type of lean status groups.

To further test the hypothesis, Mann-Whitney tests were used to follow up the above finding. It appeared that no significant differences in all organisational change factors between non-lean and in-transition firms ($p<.05$). However, there are significant different of organisational change factors between non-lean and lean firms, and between in-transition and lean firms except for item Reward System. Hence, these results have rejected the null hypothesis and accept the alternative hypothesis that states that significant different on organisational change factors between individual lean status groups.

5. CONCLUSION

On the whole, the main aim of this paper was to study the relationship between organisational change (change readiness, production team, leadership and management support, worker empowerment, effective communication, employee training, change agent system, reward system and review process) and lean implementation. The cluster analysis produced three groups named according to their degree of involvement towards lean practices. Lean firms have the highest mean scores of lean practices implementation compared to in-transition and non-lean firms. In addition, it also gives insight into the efforts of organisational change factors that in non-lean, in-transition and lean firms.

Table 4: Kruskal-Wallis test results on organisational change factors for non-lean, in-transition and lean companies

Description		Mean			Kruskal-Wallis	
		Non-lean	In-transition	Lean	df	Result
1.	Change readiness: the management	3.32	3.39	4.25	.010	Sig
2.	Change readiness: the employees	3.66	3.85	4.37	.002	Sig
3.	Production team	3.51	3.82	4.44	.001	Sig
4.	Leadership and management support: the top management	3.46	3.79	4.19	.017	Sig
5.	Leadership and management support: the middle management	3.40	3.65	4.33	.004	Sig
7.	Effective communication	3.30	3.43	4.23	.000	Sig
8.	Employee training	3.19	3.43	4.10	.007	Sig
9.	Change agent system	3.40	3.69	4.07	.029	Sig
10.	Reward system	3.43	3.35	3.70	.219	Not sig.
11.	Review process	4.00	3.89	4.36	.044	Sig

The results obtained from Kendall's tau test show that organisational change has a positive relationship with lean implementation. Higher lean implementation status can be associated with higher organisational change factors except for reward system. To further investigate the relationship of organisational change factors towards lean implementation, a hypothesis was developed. The results from Kruskal-Wallis test indicate that all organisational change factors were significantly affected by lean status groups except for "Reward System". The Mann-Whitney test used for follow-up of the Kruskal-Wallis findings, provide further support to reject the null hypothesis and accept the alternative hypothesis that states that significant different on organisational change factors between individual lean status groups.

The elaboration in the analysis of organisational change in lean manufacturing permits practitioners especially in automotive industry to obtain better understanding in managing change for successful lean implementation. The findings also highlight those areas in the organisational change where improvement should have been made.

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