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Managing change in lean manufacturing implementation

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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 system. The transition to lean manufacturing requires radical change which involves a total reshaping of purpose, system and culture of the organisation. This paper presents an investigation on the influence of organisational change to the transition of lean manufacturing. This study used an explanatory mixed method approach, which began with survey distribution, and then the general picture was further refined by conducting in-depth interviews on Malaysia automotive companies. The results revealed that company which emphasized on leadership and management, change agent system, effective communication, worker's empowerment through training and team development, and also lean review system experienced smooth transition to lean manufacturing system. Failure to recognize the required organisational changes to adapt lean manufacturing system will hinder the long-term benefits of the organisation.

Introduction

Today, change is not an exception but a steady going process. As change has its own impact on both processes and people, thus attention is required. Organisational change management is a practice that ensures the personal elements are aligned with the business strategy, technology and business process. Jones *et al.* [1] defined organisational change as the process by which organisations move from their present state to some desired state to increase their effectiveness. Whereas, Greenan *et al.* [2] pointed that organisational change is the change in the distribution of power, skills, information or communication with the changes in the distribution of skills and in skill requirement. It is suggested that, if a company is to change to a lean organisation, the company also needs to change the way they value the different dimensions of work.

The change to lean manufacturing system is a radical process and not an easy task [3]. Lean manufacturing represent a holistic approach to change. In order to create the foundation for lean manufacturing to take hold, a significant organisational change must occur within the organisation. According to Narang *et al.* [4], the process of lean transition requires significant changes in the functions of the company. In the analysis of managing the change towards a lean enterprise, Smeds *et al.* [3] mentioned that lean transition requires emergent strategy. This emergent strategy emerges when the environment of the organisation becomes recognised and legitimised. Changes that requires in lean manufacturing can be divided into four categories as suggested by Cao *et al.* [5]. Table 1 show the changes requires during the transition to lean manufacturing.

Lean manufacturing involves changing and improving process. In order to success, there are prerequisites to the transition of lean manufacturing. Leadership and management commitment is the most critical success factors in lean manufacturing followed by communication, team development, cultural readiness and employee autonomy. Transformation to lean manufacturing system can fail if the relationship between organisational changes is not fully understood. To stay competitive in today's global manufacturing environment, companies must develop a systematic change process and plan to support lean manufacturing implementation.

Table 1: Organisational Changes Required in Lean Manufacturing Implementation

Categories in organisational change	Changes in lean manufacturing	Authors
Changes in process	Application of the full set of lean tools, multi-skilled worker.	[6]
Changes in function, co-ordination and control	Teamwork building, cross-functional movement, network relationship with suppliers and customers, information transparency, participative management, teamwork rewarding.	[7]
Changes in values and human behaviour	Teamwork, open communication and information sharing, continuous improvement culture, knowledge learning and sharing.	[7]
Changes in power within the organisation	Decentralised responsibilities, autonomous leadership.	[8]

So far, there is little discussion about the link between the organisational change management and lean manufacturing implementation. In fact, one of the major challenges of lean implementation is guiding the change journey as detailed in the implementation plan. This is because lean manufacturing requires change in structure, system, process and employee behaviour [4]. This idea leads to the necessity for more research for the successful implementation of lean manufacturing process where the organisational change is effectively managed. Therefore, we need to understand what is the nature of organisational change in lean manufacturing and what are the elements needed to ensure the successful implementation of lean in a manufacturing firm. The aim of this paper is to examine the impact of organisational change to successful implementation of lean manufacturing system. Failure to recognize the required organisational changes to adapt lean manufacturing system will hinder the long-term benefits to the organisation.

Research methods

For this study, an explanatory mixed method design was employed, where the organisational change factors in lean manufacturing implementation were first investigated by quantitative method and then further explained by qualitative approach. In this design, the quantitative and qualitative data were collected sequentially, where the first phase was survey distribution and then followed by in-depth interviews to help explain or elaborate on the quantitative results. The advantage of this research design is the quantitative data and results provide a general picture of the research problem; and then more analysis is done through qualitative data collection that will refine, extend and explain the general picture [9].

Survey In this stage, a questionnaire was developed for data collection. In order to achieve the objectives of the study, the Malaysian automotive manufacturing companies were selected as the target population. The list of the manufacturing companies consists of electrical, electronic, metal, plastic, rubber and other automotive components. The manufacturing companies involved in this study were ranged from medium to large companies, with more than 50 employees. According to SME Corp Malaysia [10], medium companies are those with full time employees between 51-150, whereas large companies are companies that have full time employees more than 151. The decision made in this study is based on the studies done by Shah and Ward [11], Bonavia and Marin [12], and Perez and Sanchez [13]. From their studies, it is shown that small manufacturing companies are less likely to implement LM concepts due to certain limitations and barriers. The personnel involved in the survey were those from managing directors, manufacturing and/or production managers and executives, and also quality managers and executives.

The questionnaire consisted of four parts: (a) the background information of the organisation (year of establishment, ownership, number of employees, and quality system certification); (b) the lean manufacturing implementation (lean practices implementation,); (d) the organisational change factors and (d) the respondent information (job title, department and years of employment). The items of *lean manufacturing implementation* section were adapted from Shah and Ward [11] and

Panizzolo [14]. 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.

The prime consideration of the questionnaire design in this survey instrument was to keep it short and focused in order to obtain an adequate response rate. In the case of reliability test, Cronbach's alpha was employed to measure the internal consistency of the research instrument. All the results proved the survey instrument have high internal consistency with Cronbach's alpha values ≥ 0.70 and therefore it is reliable.

Case study Three Malaysian automotives manufacturing companies were chosen for the in-depth interview. These companies were selected based on their willingness to participate and experience in implementing lean initiatives. The authors prepared the data collection by first contacting each company to be studied to gain their cooperation, explained the purpose of the study, and recorded the key contact information. A semi-structured interview guide was developed upon a common case study protocol inferred from the review of literature, and quantitative survey done prior to the case study. The interview protocol was developed to probe lean barriers that delayed the lean implementation process in automotive companies. To improve the research reliability, the same interview protocol was used to different interviewees for triangulation purposes. The need for triangulation arises from the ethical need to confirm the validity of the data obtained [15]. The interview subjects are questioned with regard to their actual experiences. The interviews were conducted for approximately two hours for each respondent. They involved key personnel in the company that are directly involved in the implementation of lean manufacturing.

Results and Discussion

Survey The initial questionnaire was sent to 150 target respondents through emails. However, a total 19 responses were returned. This actually gave quite a low response rate of 12.7%. 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%.

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.

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

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's 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 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.

Table 3: Kendall's tau correlation coefficient and Kruskal-Wallis test results of organisational change variables and lean implementation status

Organisational change factors	**Kendal's tau**	**Kruskal-Wallis**	
	(r)	**df**	**Result**
Change readiness: the management	0.394**	.010	Sig
Change readiness: the employees	0.335**	.002	Sig
Production team	0.464**	.001	Sig
Leadership and management support: the top management	0.301**	.017	Sig
Leadership and management support: the middle management	0.422**	.004	Sig
Effective communication	0.441**	.000	Sig
Employee training	0.384**	.007	Sig
Change agent system	0.354**	.029	Sig
Reward system	0.109	.219	Not sig.
Review process	0.211	.044	Sig

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.

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 tob perform a Kruskal-Wallis test. Table 3 also shows result of Kruskal-Wallis test to compare the means of organisational change factors between non-lean, in-transition and lean companies. In Kruskal-Wallis test, the test statistic that need to be reported are its degree of

freedom and its significant. The findings in Table 3 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.

Case study The analysis of the case companies yielded interesting results. As can be seen, the three companies have different experiences compared to each other. Table 4 presents the summary of the case companies' background involved in the study.

Table 4: Summary Of The Case Companies' Background

	Company A	**Company B**	**Company C**
Type of product	Electronics	Metal	Electrical
Company age (years)	27	11	31
Company ownership	Foreign	Local	Joint Venture
Company size	Large	Large	Large
Lean effort	1996 (1st attempt), 2002 (2nd attempt)	2004 (1st attempt), 2007 (2nd attempt)	Aug 2009

In order to create the foundation for lean manufacturing to take hold, a significant organisational change must occur within the organisation. This raises key questions: How the company change to lean manufacturing system? How organisational change factors assist these companies to lean manufacturing system smoothly? In order to establish the organisational factors that support the smooth transition to lean manufacturing system, a cross case analysis was performed upon data obtained from each of the case companies. The findings discovered through theme coding in the NVivo 8 program are briefly discussed in Table 5.

The theme organizational change factors involving factors that assisting the smooth transition of an organization in lean manufacturing system. The most influential factor of organizational change is change readiness. The keywords "create awareness of lean manufacturing", "ample attention and time for change process" and "create sense of need and urgency for change appeared in almost all interviews with 17% coverage. Organisational change factors such as change agent system, workers empowerment and team development also have shown prominent coverage among the interview data. The interviewees agreed, with about 16% coverage, that the factors lead to smooth transition to lean manufacturing system. However, even though the percentage coverage of leadership and management factor was smaller at 11.7%, all interviewees overwhelmingly agreed that management support is very important in lean manufacturing implementation. Keywords "clear direction and planning", "visible management support and commitment", and "clear understanding on lean manufacturing" were prominent in the interviews.

The baseline for organisational change in quantitative analysis involved the Kendall's tau correlation coefficient and Kruskal-Wallis test. The Kendall's tau correlation coefficient displayed statistically significant positive relationship of organisational change factors with lean clusters except for reward system. The result indicates that lean companies can be associated with higher organisational change factors. Highest correlation appeared between the lean clusters and production team (r= .464). Followed by effective communication (r= .441), and leadership and management support by middle management (r= .422). Another important finding of this quantitative study is the Kruskal-Wallis test result on organisational change factors in lean clusters. The result showed there are statistically significant differences of organisational change factors in different type of lean clusters except for reward system.

Table 5: Progression from Themes to Child notes for Organisational change factors

Categories (Parent Nodes)	Child Nodes	No. of references	Percentage of coverage	
Change readiness	• Ample attention and time for change process	3	4.5	
	• Create sense of need and urgency for change	2	3.3	16.9
	• Create awareness of lean manufacturing	3	9.1	
Leadership and management	• Clear direction and planning	2	5.9	
	• Provide resources such as time, materials and money	2	0.8	11.7
	• Visible management support and commitment	3	2.6	
	• Clear understanding on lean manufacturing	1	2.4	
Communication	• Provide more information on lean manufacturing initiatives	3	3.7	
	• Get feedback from workers	3	2.9	14.9
	• Acknowledgement of lean achievement	2	0.8	
	• Information sharing between departments	2	2.1	
	• Information sharing between management and workers	3	5.4	
Change agent system	• Permanent staffs	3	2.2	
	• Competent in lean knowledge and experience	3	5.0	
	• Creative	2	0.6	15.8
	• Formal lean manufacturing department	3	3.1	
	• Support from outside expertise	3	4.9	
Team development	• Existence of lean team	3	3.5	
	• Cross-functional team	2	1.9	
	• Teamwork	3	5.2	15.4
	• Focus on continuous improvement	3	4.1	
	• Autonomous team	2	0.7	
Workers empowerment	• Training on principles of lean and lean tools	3	11.4	15.6
	• Reward system	3	4.2	
Review system	• Internal review	2	5.9	
	• External review	3	2.3	13.8
	• Periodical review	3	5.6	

The qualitative data gained from interviews conducted has resulted with seven categories and 28 child nodes. Those categories included change readiness, leadership and management, communication, change agent system, team development, workers empowerment, and review system. The highest percentage of keyword coverage among the interviews was change readiness. This revealed that change readiness should be applied comprehensively to facilitate smooth lean manufacturing transition. Among the initiatives suggested and implemented by the interviewees were "create awareness of lean manufacturing", "give ample attention and time for change process", and "create sense of need and urgency". Next categories followed by change agent system, workers empowerment, and team development. These findings further support the survey results which indicate that the highest correlation is between the lean clusters and production team.

Conclusion

On the whole, the main aim of this paper is to understand how organisational change factors assist manufacturing companies in transition to lean manufacturing system. Given the observations and results of this study, it appears that there are some factors that need to be emphasised for smooth transition to lean manufacturing system. The organisational change elements that the company has emphasized are strong leadership and management, capable change agent system, effective communication, worker's empowerment through training and team development, and also extensive lean review system.

The change to lean manufacturing system is not an easy task. As lean implementation is a systemic effort, it is important to understand the organisational change issues related to lean manufacturing. This work is of particular significance not only because it is about lean

manufacturing, but because it is set in a context of the transition in lean manufacturing that many manufacturing companies will be undertaking in the future. This work is intended to provide practitioners with a better understanding of the lean transition and unambiguous guidance to minimize the resistance and conflicts of implementing lean manufacturing system.

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