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Research paper

Lean Tools and Techniques: A Comparison between Malaysian Manufacturing and Services Organisations

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Abstract

The purpose of this study is to compare lean tools and techniques in terms of the awareness, usage, effectiveness and potential future adoption between Malaysian manufacturing and services organisations in order to help Malaysian organisations to select, adopt and implement the right lean tools and techniques based their context. An online questionnaire survey of 114 respondents from 15 states in Malaysia was conducted. The quantitative data were gathered and analysed using the Statistical software. The findings of the survey indicated that there are no significance differences ($p<0.05$) between both manufacturing and services organisations for majority of lean tools and techniques. Nevertheless, Malaysian manufacturing organisations has indicated more prone to adopt some lean tools and techniques compared to services organisations.

Keywords: *Lean Tools and Techniques; Manufacturing vs Services*

1. Introduction

Globalisation has made industries more aware of the consequences of ignoring competition in business. In order to remain competitive, Malaysian manufacturing and services industries, are facing challenges such as inconsistent of customer demand, rising customers's expectation and competition in the market, therefore the manufacturers and services organisations need to embrace changes and improvements in their key activities and/or process in order to cope with the challenges [1]. To extricate from this issue and become profitable, many industries have started to turn to lean principles to elevate the performance of their firms. Lean production is most frequently associated with the elimination of seven important wastes to ameliorate the effects of variability in supply, processing time or demand [2]. Lean production is also known as manufacturing without waste. The waste is consists of non-added value to the product. There are seven type of waste such as overproduction, waiting time, transportation, inventory, inappropriate processing, excess motion and product defects [3-5].

Lean Production is one of the improvement initiatives that can be implemented to achieve business excellence [6]. Current studies show that, there are more than 50 lean tools and techniques that are widely used, depending on the size of the industries [7]. In Malaysia, varies studies was found related to lean production tools and techniques adoption and implementation especially in automotive [8-10], electrical and electronic [1], and food and beverage industries [11] in order to achieve higher performance improvement. Based on studied by Khusaini, N. S. et. al. (2014) [11], found that most of the Malaysian manufacturing industries such automotive, electrical and electronics, and food and beverage have adopted and implemented 18 lean tools and techniques such as 5S, Cellular manufacturing (CM), Kaizen, Poka-Yoke, Setup time reduction (SMED), Standardized work (SW), Value stream mapping (VSM), Jidoka (Zero defect), Andon (lighting signal), Group technology, Heijunka, Just in time (JIT), Kanban, One piece flow, Plan–do-check-act (PDCA), Root cause analysis, Takt time, and Total productive maintenance (TPM).

One study was found related to lean implementation at services industries in Malaysia such as healthcare [12]. In the service organization, lean is applicable to organizations that have limited information and face interruption on task performance because the services encounter high costs with non-value added activities and slow processes, which lead to poor quality and low customer satisfaction [13]. According to Manzouri, M. et. al. (2010) [14], the highest level of obstacle for Malaysian companies in implementing improvement programs are lack of experts' employees and lack of awareness. Therefore, the purpose of this paper is to compare the level of awareness, current usage, effectiveness and future adoption of the 10 main lean tools and techniques for Malaysian manufacturing and services organisations.

2. Method of Research

A questionnaire based research was used in this study. The responses from a large number of geographically disparate respondents are acquired around Malaysian state. The survey was conducted in order to achieve quick respond rate and enables a larger amount of data to be gathered [15].

2.1 Questionnaire Design and Validation

The questionnaire was designed using close-ended questions in order to make ease of answering. A dichotomous 'yes/no' answer was used for the current usage and future adoption of lean tools and techniques, whilst an ordinal scale of 'don't know/very low/low/moderate/high/very high' was used for the awareness and effectiveness of the lean tools and techniques. Respondents were asked for just answer questions that were pertinent to their usage (or non-usage) of the tools and techniques. For instance, just organisations that used the tools and techniques could rate their level of effectiveness.

As suggested by Delgado-Hernandez and Aspinwall (2005) [16], in order to further minimise the potential misinterpretation of the lean tools and techniques over the different states, the researchers ensured a definition for each lean tool and technique was shown inside the questionnaire. After pilot test had been done, the comment and feedback from experts on the subject were analyzed and a few minor corrections were made to improve the instrument. The reliability of the questionnaire was checked using Cronbach's alpha coefficient to quantify the internal consistency of the research instrument. According to Sekaran, U. (2005) [17], the reliability measurement is an indication of the stability and consistency of the instrument. Generally, the agreed value of the lower limit for Cronbach's alpha is 0.70, but it could be as low as 0.60 in exploratory research [18].

The elements of lean tools and techniques were tested for the internal consistency using SPSS reliability analysis procedure. The results show and proved that the survey instrument is reliable and has high internal consistency with Cronbach's alpha values 0.853 which is $\geq$ 0.70 and therefore this instrument is reliable.

2.2 Sampling, Questionnaire Distribution and Analysis

The samples of this study were obtained from Malaysian Productivity Corporation (MPC) database and Federation of Malaysian and Manufacturers (FMM) database. The respondents involved in this study consist of directors, managers, engineers, executives, and academician.

These respondents were considered the best candidate to answer the survey because they are directly involved in the process. Data collection method was random sampling. Before the questionnaire had been distributed, it was translated from Microsoft word to online version using Google documents (www.google.com). The online questionnaire was distributed through invitation emails. To analyse the questionnaire responses in this study, the IBM SPSS Statistics software package was used. As suggested by Kohlmann, T. (2009) [19], to analysed the ordinal questions, the Mann–Whitney U test was used, whereas the chi-square test for analysed binary questions.

3. Results and Discussion

3.1 Survey Findings

The survey was emailed to 320 industries and a total of 114 responses were returned resulting in 35.6% valid response rate including response after follow up email. From 114 respondents, 75 (66%) were from manufacturing organisations and 39 (34%) were from services organisations. For the portion of respondents' position in their organisations, the results show that, most of the respondents involved in this study are from practitioner which is executives / engineer levels (51%) followed by managers levels (28%), Chief Executive Officer (CEO) level (11%), Academics/ researcher (7%) and 3% respondents are from specialist / consultant involved in implementing lean tools and techniques.

3.2 Manufacturing Vs Services Organisations

A Mann-Whitney U test was used to analyse the differences between two organisations (manufacturing and services) in term of their level of awareness for each lean tools and techniques using a scale of 0 for don't know, 1 for very low, 2 for low, 3 for moderate, 4 for high and 5 for very high awareness. Based on the results as shown in Table 1 below, there were the statistically significant differences ($p<0.05$) between two organisations in terms of Poka-Yoke ($p=0.023$) and Kanban ($p=0.016$). The results indicate that manufacturing organisations have a better awareness of both lean tools and techniques (Poka-Yoke and Kanban) compared to services organisations. This could be due to a number of reasons, such as for manufacturing organisations, customer demanding to use of these lean tools and techniques to enhance the quality of their products and/or to diminish waste and cost [20]. While, for service organisations, normally do not create tangible products and this could make them less likely to know about some of these lean tools and techniques. Matthew, T. et. al., (2015) [21] and Burgess, N. and Radnor, Z. (2013) [22], also state that another reason, why certain lean tools and techniques at manufacturing organisations much higher in terms of level of awareness may be because of the lean tools and techniques are a relatively recent introduction to the service organisations.

Table 2 shows the results of a Chi-square test that investigating the differences of lean tools and techniques usage among manufacturing and services organisations. Respondents were asked to answer Yes or No in order to state that they were currently using each lean tools and techniques. The results show statistically significant differences ($p<0.05$) for Cellular manufacturing (CM) ($p=0.000$), Kaizen ($p=0.016$), Poka-Yoke ($p=0.000$), Value stream mapping (VSM) ($p=0.022$), Jidoka ($p=0.003$), and Kanban ($p=0.000$).

Table 1: Results of Mann-Whitney U test for awareness level of lean tools and techniques (manufacturing vs. services)

Lean tools and techniques	Manuf.		Services		Sig.
	N	Mean Rank	N	Mean Rank	
5S	75	59.51	39	53.63	0.337
CM	75	61.52	39	49.77	0.062
Kaizen	75	60.93	39	50.91	0.113
Poka-Yoke	75	62.43	39	48.03	0.023
SW	75	58.13	39	56.28	0.766
VSM	75	61.25	39	50.28	0.084
Jidoka	75	61.25	39	50.28	0.085
Kanban	75	62.77	39	47.36	0.016
PDCA	75	59.93	39	52.83	0.263
TPM	75	60.05	39	52.59	0.242

Table 2: Results of Chi-square test for the usage of lean tools and techniques (manufacturing vs. services)

Lean tools and techniques	Manuf.		Services		Sig.
	Count Yes	% Yes	Count Yes	% Yes	
5S	67	89.3	32	82.1	0.275
CM	46	61.3	10	25.6	**0.000**
Kaizen	57	76.0	21	53.9	**0.016**
Poka-Yoke	52	69.3	13	33.3	**0.000**
SW	63	84.0	32	82.1	0.791
VSM	38	50.7	11	28.2	**0.022**
Jidoka	41	54.7	10	25.6	**0.003**
Kanban	43	57.3	9	23.1	**0.000**
PDCA	59	78.7	25	64.1	0.094
TPM	48	64.0	18	46.2	0.067

The results indicate that manufacturing organisations more likely to use Cellular manufacturing, Kaizen, Poka-Yoke, Value stream mapping (VSM), Jidoka, and Kanban compared to services organizations. From the results, it indicates that, the level of awareness is reflected to the usage. The implication is that for the

most majority of lean tools and techniques, awareness is probably going to lead to usage. Even though some manufacturers are aware of these lean tools and techniques, but some of them have decided not to use that lean tools and techniques may be because of a numbers of factors that affect their decision such as costs of implementation [23], current maturity level, and so on.

Therefore, manufacturing organisations which put more emphasis on 'hard' and tangible production will probably utilize certain lean tools and techniques in comparison with service organisations which have 'softer' and less tangible outcomes [24]. The findings from this study, therefore the higher of the awareness level, the usage rate also will be higher.

Meanwhile, table 3 shows the results of Mann-Whitney U test for the level of effectiveness for lean tools and techniques. Respondents were asked to rate the level of effectiveness for each lean tools and techniques using a scale of 0 for Don't know, 1 for very low, 2 for low, 3 for moderate, 4 for high and 5 for very high effectiveness. The results indicate that, there were statistically significant differences ($p<0.05$) for Cellular Manufacturing ($p=0.006$), Kaizen ($p=0.012$), Poka-Yoke ($p=0.000$), Standardized work ($p=0.027$), Value stream mapping (VSM) ($p=0.012$), Jidoka ($p=0.001$), and Kanban ($p=0.000$). The mean rank value results indicate that manufacturing organizations rate for these lean tools and techniques higher in terms of the effectiveness compared to services organisations counterparts.

From the results, it shows that most of the lean tools and techniques are more effective in manufacturing organisations compared to services organisations. This may be due to the maturity level of manufacturing organisations, and also supporting from government such as Malaysian Productivity Corporation and Federation of Malaysian Manufacturing in order to successfully improve their productivity and reducing waste.

Table 3: Results of Mann-Whitney U test for the effectiveness of lean tools and techniques (manufacturing vs. services)

Lean tools and techniques	Manuf.		Services		Sig.
	N	Mean Rank	N	Mean Rank	
5S	75	59.55	39	53.56	0.334
CM	75	63.27	39	46.40	**0.006**
Kaizen	75	62.97	39	46.97	**0.012**
Poka-Yoke	75	65.57	39	41.97	**0.000**
SW	75	62.28	39	48.31	**0.027**
VSM	75	62.60	39	47.69	**0.012**
Jidoka	75	64.27	39	44.49	**0.001**
Kanban	75	65.32	39	42.46	**0.000**
PDCA	75	60.82	39	51.12	0.125
TPM	75	61.07	39	50.63	0.098

Table 4 demonstrates the results of a Chi-square test that investigating the distinctions of future adoption for lean tools and techniques amongst manufacturing and services organisations. Respondents were asked to give the answer Yes or No to identify whether or not they intends to use each lean tools and techniques in the foreseeable future. The results indicate that there were statistically significant differences ($p<0.05$) for Cellular manufacturing ($p=0.003$), Poka-Yoke ($p=0.006$), Standardized work ($p=0.032$), Value stream mapping (VSM) ($p=0.001$), Jidoka ($p=0.003$), Kanban ($p=0.000$) and Total Productive Manintenance (TPM) ($p=0.021$), where manufacturing organisations shows more likely to use these lean tools and techniques in the future compared to services organisations counterparts. From the results shows that, Malaysian manufacturers are probably going to be more proactive in future adoption of lean tools and techniques for example, Cellular manufacturing (CM), Poka-Yoke, Standardized work (SW), Value stream mapping (VSM), Jidoka, Kanban, and furthermore Total productive maintenance (TPM) that they at present utilized.

Table 4: Results of Chi-square test for the future adoption of lean tools and techniques (manufacturing vs. services)

Lean tools and tech-niques	Manuf.		Services		Sig.
	Count Yes	% Yes	Count Yes	% Yes	
5S	72	96.0	38	97.4	0.693
CM	54	72.0	17	43.6	**0.003**
Kaizen	68	90.7	31	79.5	0.094
Poka-Yoke	59	78.7	21	53.9	**0.006**
SW	73	97.3	34	87.2	**0.032**
VSM	57	76.0	18	46.2	**0.001**
Jidoka	57	76.0	19	48.7	**0.003**
Kanban	53	70.7	14	35.9	**0.000**
PDCA	64	85.3	30	76.9	0.263
TPM	61	81.3	24	61.5	**0.021**

The important implication of this finding is that Malaysian services organisations still laq in their intention to use some of the lean tools and techniques. This study is in agreement with study by Matthew Tickle et. al. (2015) [21] and Mohammad, M. et.al. (2016) [25], where the services organisations still lag in some tools and techniques, due to these lean tools and techniques still primarily associated with production.

4. Conclusion

This study has investigated the level of awareness, usage, level of effectiveness, future adoption of lean tools and techniques by comparing manufacturing and services organisations in Malaysia. The result of the study has important managerial implications especially for managers. It is important for managers to know the current levels of awareness for lean tools and techniques based on their nature of business in order to help them to adopt and consequently, improve their knowledge of lean tools and techniques which is lacking. These findings could help also Malaysian Productivity Corporation (MPC) and also Federation of Malaysian Manufacturing (FMM) for planning, preparing, and conducting training for Malaysian manufacturers and services organisations related to the lean tools and techniques to be adopted for the near future.

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