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5s, Kaizen and Organization Performance: Examining the Relationship and Level of Implementation Using Rasch Model in Malaysian Automotive Company

Mohd Norhasni Mohd Asaad[1], Rohaizah Saad, Rushami Zien Yusoff

Universiti Utara Malaysia

[1]mnorhasni@uum.edu.my

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Abstract

The study of organizational performance through the development of many highlights of the literature shows that it requires further research. This is because although the topic of organizational performance is widely discussed by researchers, particularly in the adoption of Japanese management methods such as 5S and Kaizen, it still has not found a concrete conclusion why some organizations do face failure. The purpose of this study is to investigate the relationship between 5S, Kaizen and the organizational performance and also to examine the level of 5S and Kaizen implementation in the organization. This study used Item Response Theory (IRT) to examine the level of implementation of 5S and Kaizen in the Malaysian automotive companies. Rasch model with Winsteps 3.6 software was used in this study because of its ability in interpreting and analyzing the ability of respondents in performing difficult items. Online questionnaires were distributed to 63 automotive companies selected randomly in the Northern Region of Malaysia.
The results showed that there was a relationship between 5S, Kaizen and organization performance where it was easier to implement the practice of 5S compared to Kaizen. The successful implementation of 5S and Kaizen was greatly influenced by top management commitment.

INTRODUCTION

Most manufacturing industries are currently encountering a necessity to respond to the rapid changing of customer needs, desires and tastes. For industries, to remain competitive and retain market share in this global market, continuous improvement of manufacturing system processes has become a necessity. Competition and continuously increasing standards of customer satisfaction has proven to be the endless driver of organizations performance. According to Reichhart and Holweg (2007) lean manufacturing is the best production systems in various industries. Lean manufacturing consists of some lean tools such as 5S and Kaizen (Lanigan, 2004; Ramakrishnan & Testani, 2010). 5S and Kaizen lean tools represent the most widely adopted by the industry (Collins, 2008). However, not many studies were conducted to evaluate the implementation of 5S and Kaizen in

the industry. Some deal with failures in the implementation of 5S and Kaizen to improve organizational performance (Taleghani, 2010).

5S

Lanigan, (2004) translates the Japanese 5S as organization – clearly distinguishing between what is needed and to be kept and what is not needed and to be discarded; orderliness – organizing the way that needed things are kept so that anyone can find and use them easily; cleanliness – sweeping floors and keeping things in order; standardized cleanups – organization, orderliness and cleanliness are being maintained; discipline – always following specified (and standardized) procedures. Table 1 shows the different definitions of Seiri, Seiton, Seiso, Seiketsu and Shitsuke.

Table 1:
Authors and 5S Definition

5S / Author	(Lanigan, 2004)	(Hutchins, 2007; Lynch, 2005)	(Sobanski, 2009)	(Abdullah, 2003)
Seiri	Organization	Sort	Sort	Sort
Seiton	Oderliness	Set	Set in Order	Straighten
Seiso	Cleanliness	Shine	Shine	Scrub
Seiketsu	Standardized cleanup	Standardized	Standardize	Standardize
Shitsuke	Discipline	Sustain	Sustain	Systematize

Many articles on 5S have been published over the past decade. Although the majority of these articles supported the benefits of adopting this management philosophy in various types of organizations, some of them (Hutchins 2007) argued that 5S did not work. For instance, the role of 5S in improving business performance and the long period of time that it takes for this improvement to be effective have been the target of some opponents of this management philosophy. However, 5S seems to have survived these opposing points of view since many companies continue to implement it and various articles continue to be published in this area.

Kaizen

In Japan, Kaizen means continuous improvement (Suárez-Barraza & Smith, 2014) . It is run slowly, increasing from time to time but continuously. Meanwhile, in America it is known as "Kaizen Blizt" or "Kaizen Event". According to Abdullah, (2003), Kaizen is a systematic approach to the gradual, orderly and improvements. It can be run in a variety of places such as inventory reduction and the reduction of damaged goods. To Toyota Company, kaizen is part of the corporate culture in which all employees always think to make improvements. It encourages workers to carry out small improvements known as "Mini Kaizen". Implementation of the "Mini Kaizen" sometimes takes longer than the Kaizen Blizt but it can last a long time, as evidenced by the Toyota Company, to strive and maintain a competitive advantage (Lee & PE, 2010). According to Singh and Singh, (2009), Kaizen refers to continuous improvement in performance, cost and quality. Kaizen strives to empower the workers, increase workers satisfaction, and facilitate a sense of accomplishment, thereby creating a pride of work. It does not only ensure that manufacturing processes becomes leaner and fitter, but also eliminate waste where value is added.

According to Oki, (2012), implementation of Kaizen largely failed because of the culture of the organization. One cause is the management of the organization. Toni, Eileen, Jennifer, June, and Jeremy, (2008) on the other hand stated that the implementation of Kaizen shall begin with the leadership's commitment in ensuring the success of this program.

In conventional practice, management leadership also serves as a bridge that is used by leaders to influence the attitudes and behaviours of their members to achieve organizational objectives (Harbour, 2001). In fact, according to Burch, (2008), participation of workers in decision-making and communication can help the organizations achieve and sustain success. Rashid, Sambasivan and Rahman, (2004) argue that a change in

attitude does not only involves to the management but also involves all employees in order to create a lasting change in the organization.

Organization Performance

According to Protopappa-Sieke and Seifert, (2010), the success of an organization is assessed through the performance of the organization's financial performance and non-financial performance. Operating performance is part of the non-financial performance and a production aspect of the measurement is defined as the organization as a result of organizational processes(de Leeuw & van den Berg, 2011).

The theoretical framework depicts the relationship between the variables that are being discussed. The objectives of this study are to examine the relationship between 5S and Kaizen as independent variable and organizational performance as dependent variable. Another objective of this study is to measure the level of 5S and Kaizen implementation among the organizations. Figure 1 below illustrates the proposed theoretical framework for this study.

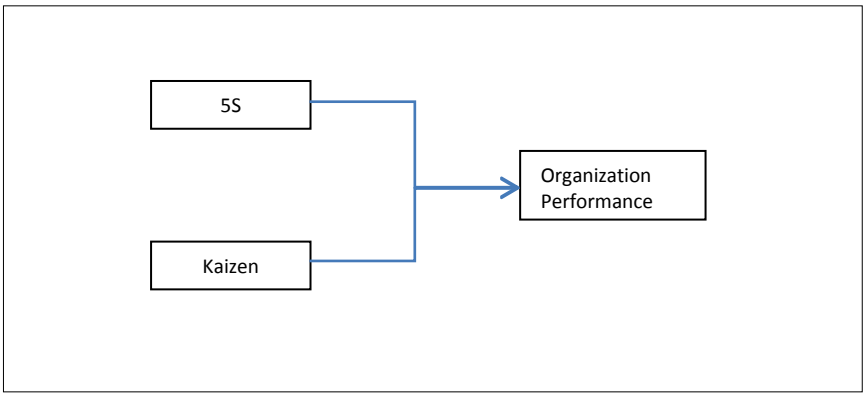

Fig 1: Research Framework

RESEARCH METHOD

Researchers use quantitative methods of evaluation. The survey is the method of research conducted to collect data from the population. Through this method, the researchers do not need to get data from the entire population of interest but instead, they just need to look at some elements of the population. The questionnaire is used for the purposes of this investigation. The questionnaire is an important instrument for a researcher because, a the quality questionnaire will determine the value of research as a whole (Sekaran & Bougie, 2010). To obtain information for the purpose of research a questionnaire was developed.

The questionnaire is designed to assess an organization's ability to implement 5S and Kaizen to improve organizational performance. It was developed based on an extensive review of work and also the opinion of experts involving representatives of management within the organization. Reliability testing is performed to ensure consistent measurement over time and include items instruments. In the Rasch model the reliability of the instrument can be seen through the items and reliability of the person (Andrich, 2011).

For purposes of analysis using software Winsteps 3.6, 5S questions are divided into five dimensions and given a code B12.X in which X indicates the number of dimensions of Seiri (1), Seiton (2), Seiso (3), Seketsu (4) and Shitsuke (5). While the questions of Kaizen are divided into four dimensional code B14.Y where the Y shows the number of its dominant dimension of the Design-Implement-Check-Action (1), kaizen events (2), the proposed employee (3) and understanding system (4). Similarly, the performance of the organization in which the dimensions are divided into six DZ code of quality (1), the cost (2), time (3), transmission (4), productivity (5) and flexibility (6). Six Likert scale measurement (Likert scale of 6 points) is used in this study. This is because the scale of measurement has no middle or neutral point (Tang, Shaw, & William, 1999).

Rasch Model

The Rasch Model is used as analysis tool in identifying the level of 5S and Kaizen implementation by the organizations. The Item Response Theory (IRT) under the group of Modern Test Theory is an underpinning theory for the Rasch Model. IRT has ability to estimate each item's difficulty as well as each person's ability on the same metric, allowing for meaningful comparisons of the two (Rijmen & De Boeck, 2005)). The Rasch model, one of the specific applications of IRT, has ability to provide linear measures from ordinal data, by the use of logarithmic transformation procedures (Alvarez & Pulgarin, 1996; González-de Paz et al., 2014).

Choice of models depends on the amount of data obtained. A larger number of parameters, more data are needed to estimate the parameters. Therefore, it requires more calculation and interpretation are more complex. Rasch model has some special features that can solve this problem. First, the Rasch model involves the fewest parameters so that it is easier to apply. Second, the Rasch model has specific objectives that allow a complete separation of items and the ability of the budget (Hambleton, Swaminathan, & Rogers, 1991). Estimated capacity can be done without trend and independently of the selected items from the items corresponding to the model. Furthermore, the budget item difficulty can be done without trend and independently of the respondents were selected from the population corresponding to the model.

In traditional tests, scattered distribution used to establish the best regression. However, prediction of response ordinal is almost impossible because of the absence scale interval. Common solutions in linear regression approach is to create a line formed of the points corresponding to the best possible, which will then be used to make predictions that are required by the interpolation or extrapolation (Bond & Fox, 2007; Saidfudin Azrilah, A. A., Rodzo'an, N. A., Omar, M. Z., Zaharim, A., & Basri, H., 2010) as shown in Figure 2 concept line with possible matches.

$$y = \beta_0 + \beta_1 m \quad (1)$$

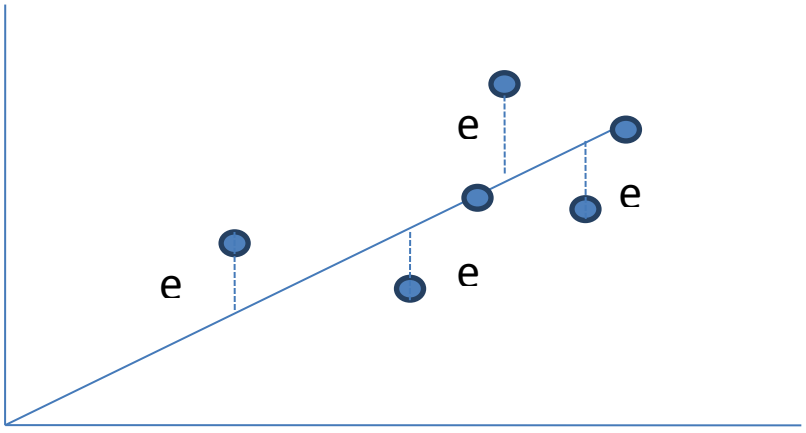

Fig 2: The concept of best fit lines

In securing the best fit lines, significant differences between the actual point ; y_i and forecasts point; Y_i on the line of best fit. This difference is referred to as an error, *e*

$$y_i - \acute{y}_i = e_i \quad (2)$$

Because there is always error involved in prediction model, deterministic model makes it less reliable. This can be overcomed by turning it into a model to forecast the probability of error in the equation;

$$y = \beta_0 + \beta_1 m + e \quad (3)$$

Under the philosophy Rasch data collected should correspond to the specifications Rasch model of trying to create "best fit lines". Rasch reliability remove the concept of creating a "line of best fit" data to remove the device size can be repeated and reliable (Linacre, 2006; Noventa, Stefanutti, & Vidotto, 2014). Rasch logit model using a scale ruler linear with the same separation gap (Aziz, 2008). Rasch model is the model of probability; it is about the opportunity to choose one rank where it involves an odd ratio. Figure 3 below shows the probabilistic line diagram

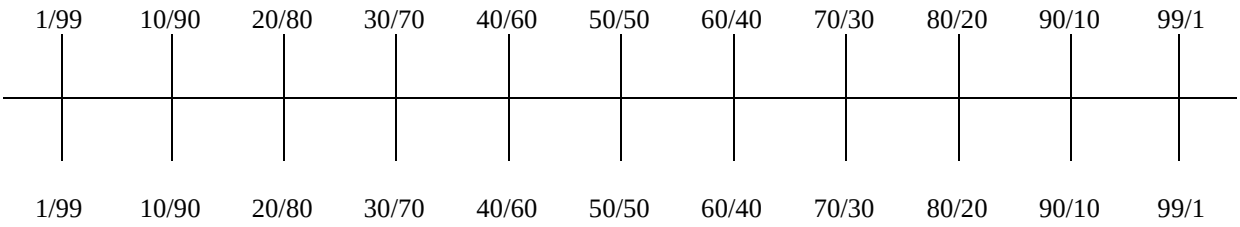

Fig 3: Probabilistic line diagram

In order to achieve an equal interval scale, the logarithm is used for odd probabilistic value in Figure 3 above. For example the value of 1/99 is equivalent to 10^{-2} when $\log_{10}$ apply to it, then $\log_{10}10^{-2}$ is equal to -2.0; value of $\log_{10}10^{-1}$ equals to -1; value of $\log_{10}1$ equals to 0 and so forth. The Figure 2 below shows the newly established logit ruler as linear scale with equal interval separation (Asaad & Rushami Zien Yusoff, 2013; Aziz, 2008).

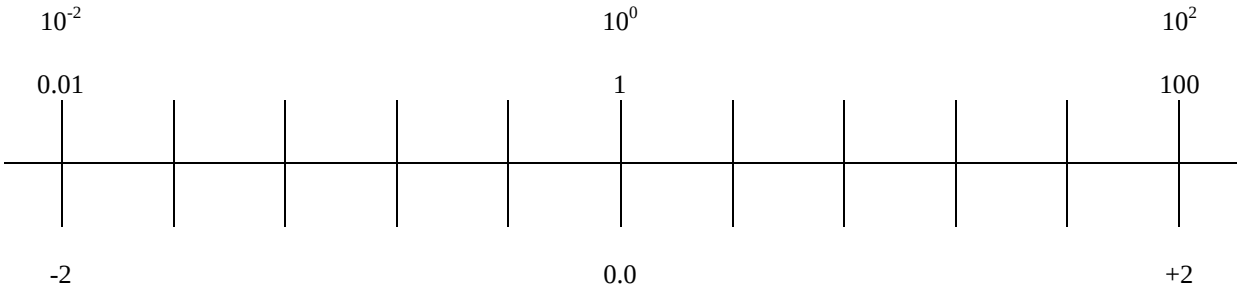

Fig 4: Logit ruler

It shows the probability of success of an event is equal to the difference between a person's ability and item difficulty. Rasch measurement model is expressed as the ratio of the success of an activity;

$$P(\theta) = \frac{e^{(\beta n - \delta_i)}}{1 + e^{(\beta n - \delta_i)}} \quad (4)$$

where:

e = logarithm base and Euler number; 2.7183
β_n = person ability
δ_i = item difficult

Based on the above theorem the rank order data can be transformed into equal interval separation. Under the Rasch philosophy the data collected have to fit the Rasch model's specification (Bond & Fox, 2007; Saidfudin Azrilah, A. A., Rodzo'an, N. A., Omar, M. Z., Zaharim, A., & Basri, H., 2010) rather than establishing "best fit line". Rasch moves the concept of reliability from establishing "best fit line" of the data into producing a reliable repeatable measurement instrument (Andrich, 2011). For the data collected to be considered as fit to Rasch Model it must meet the following criteria which are:

1. 'Point measure correlation' (PtMea Corr); 0.4 < PtMea Corr value < 0.80
2. 'Outfit mean square' (MNSQ); 0.5 < MNSQ value < 1.5
3. 'Outfit Z-standard' (ZSTD); -2 < ZSTD value < +2

The investigation and decision has to be made if any data does not meet one of the criteria. This study used the Rasch model for the analysis because it is very relevant to the analysis of quantitative data, especially in the social sciences as well as it can measure the ability of each respondent in the implementation of the items difficult (Bond & Fox, 2007).

The sample consists of companies that manufacture products and automotive components. These companies or respondents are suppliers of components and products for the automotive industry. This study focuses only on the Northern Peninsula Malaysia namely Perlis, Kedah, Penang and Perak. This is because most automotive companies operating in the northern area of the peninsula have the same type of manufacturing process. Respondents were given a six-digit code to facilitate analysis. The first two digits (12XXXX) show the number of respondents or organization while the third digit indicates the location of the questions (XX3XX), the fourth digit (XXX4XX) shows the question on number of years of operation, the fifth digit (XXXX5X) shows question number of employees and the sixth digit (XXXXX6) shows questions turnover. Based on the sample size, this study considers the results of tests on samples of this study which may reflect the results of the study population as a whole. A total of 76 companies were identified through a list of suppliers in the automaker. The sample size for the population size 76 is 63 (Krejcie & Morgan, 1970; U. Now, 2003). Thus a total of 63 companies were selected at random and should fill in the online questionnaire.

However, only 23 organizations have filled in a questionnaire online. Response rate in this study was 36% of the total questionnaires sent and 31% of the total population. The response rate was approximately equal to the previous studies in the industry in Malaysia (Habidin & Yusof, 2013; Nordin, Deros, & Wahab, 2010; Wong, 2009) According to Linacre, (1994) Rasch model can receive a minimum sample size of respondents from 16-36 representing 95% confidence interval. The unit of analysis for this study was the organization and most of the respondents are CEOs, managers, engineers and executives.

DISCUSSION

The majority of respondents were in Kedah (76%), followed by Penang (19%) and Perak (5%). The data obtained reflected the population where most of the automotive industries are in the state of Kedah, Penang and Perak. These places have a lot of manufacturing activities and some are village's vendor. There are eleven organizations (52%), which have been operating between 11-20 years, followed by six organizations (29%) between 21-30 years and four organizations (19%) between 1-10 years. The majority of organizations involved with this study employ more than 150 people comprising nine organizations (43%). Seven organizations (33%) have employees between 5 to 50 people and only five organizations (24%) of employees between 51 and 150 people. Sales revenue for these organizations showed a 43% gain in sales exceeding RM25 million, a 38% gain in sales of between RM250, 000 to 10 million and 19% earns between RM10 million to RM25 million.

Table 2 shows the average score for perception of organizations that fit to the Rasch model is the 0.0 logit, standard deviation 0:77 logit. The minimum and maximum size was between -1.21 logit until 1.41 logit. Maximum outfit mean square value (OUT MNSQ) is 1.29 logit and the minimum is 0.57 logit. ZSTD to the average item value is 0.01 logit and is between the minimum and maximum value of -1.4 to 1.0. According to William P. Fisher (2007), data fitted to the Rasch model should be (OUT MNSQ) between 0.5 and 1.5 logit, Point correlation measures between 0.4 and 0.8 logit, ZSTD between -2 and 2 logit. The reliability of the items was 0.80, while the reliability of the person is 0.96. The reliability of the person is classified as excellent above 0.94, 0.91 to 0.94 is very good, 0.81 to 0.90 is good, 0.67 to 0.80 are common, and less than 0.67 is weak (William P. Fisher, 2007). Data shows that the value is in the trusted level of reliability. All items are 95% confidential interval between data and show fit to model data and can be used for analysis.

Table 2
Summary Statistics of Kaizen, 5S and Organizational Performance

		MEASUREMENT *(Logit)*	OUT. MNSQ	OUT. ZSTD
Mean *item*		0.00	0.97	0.0
Standard deviation		0.77	0.22	0.7
Maximum		1.41	1.29	1.0
Minimum		-1.21	0.57	-1.4
Item Reliability:	0.80			
Person Reliability:	0.96			

Figure 5 shows that the overall data between two lines or Confidence Interval Curve. It shows that these data is fit where its distribution follows the Ideal Logistic Regression line.

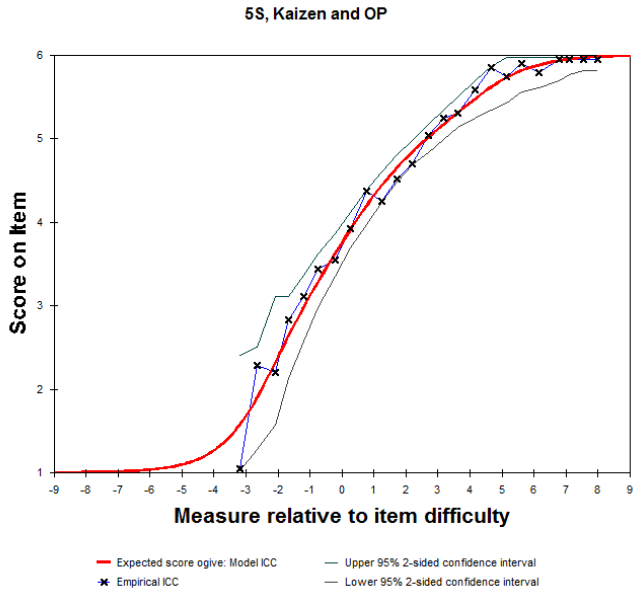

Fig 5: Expected Score Item Characteristic Curve (ICC) for 5S, Kaizen and Organizational Performance

Figure 6 shows a straight line with slope of 0.0183. This straight line proves that there is a positive relationship between 5S and Organizational Performance. This means that if there is an increase in 5S, it will also improve the performance of the organization. The findings are consistent with findings in Lynch, (2005) and Dossenbach, (2006) which showed a positive relationship between 5S and Organizational Performance.

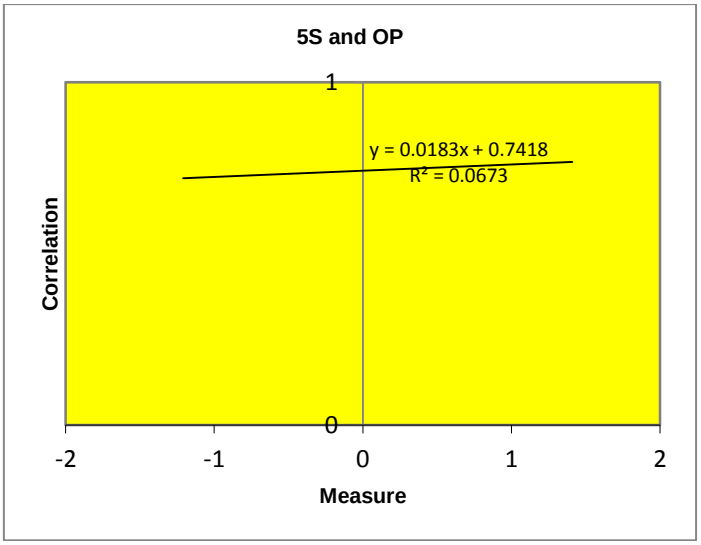

Fig 6: Expected Score 5S and Organizational Performance

Figure 7 shows a straight line with slope of 0.0111. This straight line proves that there is a positive relationship between Kaizen and Organizational Performance. This means that if there is an increase in Kaizen, it will also improve the performance of the organization. The finding is in line with the findings in Bockmiller, (1994) and Toni, Eileen, Jennifer, June, and Jeremy, (2008) where there was a positive relationship between Kaizen and Organizational performance.

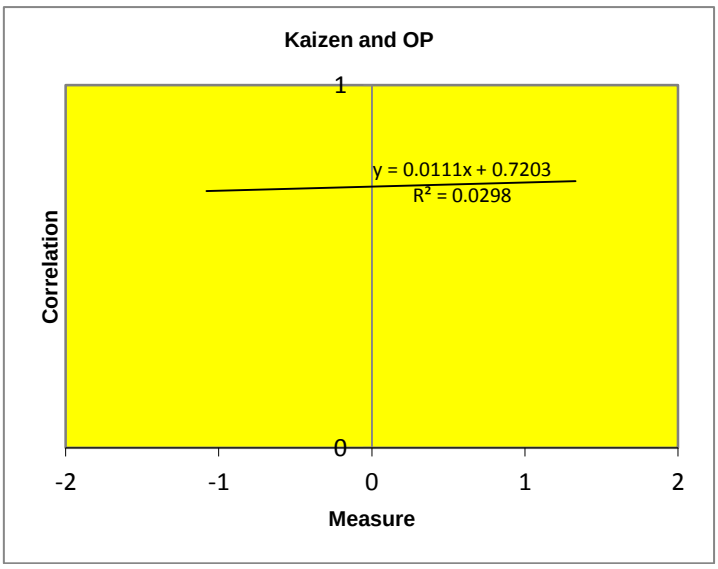

Fig 7: Expected Score Kaizen and Organizational Performance

According to the Rasch model the probability of success of an event is equal to the difference between a person's ability and item difficulty. Rasch measurement model is expressed as the ratio of the success of an event;

$$P(\theta) = \frac{e^{(\beta_n - \delta_i)}}{1 + e^{(\beta_n - \delta_i)}}$$

where:

e = logarithm base and Euler number; 2.7183

β_n = person ability

δ_i = item difficult

The probability of success can be used to determine the level of implementation of 5S and Kaizen organization towards increased performance. Table 3 shows the level of implementation of 5S and Kaizen in the organization. The probability of success for 5S implementation in the organization is 87% and the probability of success for Kaizen implementation in the organization is 85%. The level of mean 5S item is -0.15 logit, below the mean level of Kaizen item 0.06 logit. This indicates that it is easier to implement 5S practice in organization compared to Kaizen.

Table 3
Level of implementation of 5S and Kaizen in the organization

5S Implementation			**Kaizen Implementation**		
Mean Person (βn)	**Mean Item (δi)**	**Probability of success P(θ)**	**Mean person (βn)**	**Mean item (δi)**	**Probability of success P(θ)**
1.79	-0.15	87%	1.79	0.06	85%

Besides analysing the relationship between variable, Rasch Model also has capability to identify the ability of organizations in performing the difficult items of 5S and Kaizen. The Figure 8 below presents the distribution of the sample in relation to the thresholds items which is called Person - Item Map. This map indicates the ability of organizations in performing the item difficulties. The unit used is logit value. The Person-Item Map is divided into two parts on the same continuum. Along the line on the left-hand side are the respondents which are represented by automotive organizations as the unit of analysis. It is aligned in the increasing ability from bottom to top. On the right of the map is the item difficulty. It is arranged from easy to difficult item. From the map, mean person is located at 1.79 logit which is above the mean item 0.0 logit. The maximum logit for person is 6.83 logit which is represented by 092222, and the minimum logit for person is -1.91 logit represented by 0154334. The ability of respondents was arranged in descending order from the highest to the lowest ability in performing the items.

There are twelve people (respondents) above the average person (1.79 logit) and eleven people are below average. Based on the organization code, it shows person (154334) at the lowest level, and operate in the Perak state. It has been in operation between 21 to 30 years, and has between 51-150 employees and sales of over 25 million. Person (092222), which is the top level, shows the ability of the organization to carry out the entire item. This organization is in the Kedah state and has been in operation between 11 to 20 years, has 5-50 employees and achieves a turnover of between RM250,000 and RM10 million. There are four 5S items above average (0.00 logit) and eight items were below average. The lowest 5S item is easiest to implement (B12.2.1) while the highest 5S item is the most difficult to implement (B12.3.3). The lowest 5S item is easiest to answer (B12.2.1) related to question on the workplace which has a designated location. While the highest 5S item is difficult to answer (B12.3.3) related to question on wall, floors, equipment are shiny and stainless. All Kaizen items are above average (0.00 logit). The lowest Kaizen item is easiest to implement (B14.1.4) while the highest Kaizen item is the most difficult to implement (B14.4.2). The lowest Kaizen item is easiest to answer (B14.1.4) related to question on a sustainment plan with milestones. While the highest Kaizen item is difficult to answer (B12.3.3) related to question whether managers understand the impact of individual functions and departments on overall facility performance and improvement.

There are five Organization performance items above average (0.00 logit) and five items were below average. The lowest Organization performance item is easiest to achieved (B4.1) while the highest Organization performance item is difficult to achieved (B1.2). The lowest Organization performance item is easiest to answer (B4.1) related to question on time delivery. While the highest Organization performance item is difficult to answer (B1.2) related to questions on defect rate.

A total of eleven people or organizations (192233 to 092222) that were above the level of 1.14 logit, and it was easy to implement 5S and Kaizen and achieve outstanding performance. While the person or organization under

0.67 logit (B14.1.4) of 132132 to 154334 describes a difficult organization to implement Kaizen. Person or organization (154334) that is the lowest level is the most difficult to implement 5S and Kaizen. This shows that to achieve success, this organization must strive to implement 5S and Kaizen items.

CONCLUSION

A valid and reliable instrument is very crucial in ensuring the data collected can answer the research objectives. In this research the Rasch Model was used to validate the instrument. Once all the data were fitted to Rasch Model through satisfying three pre-set criteria, further analysis was conducted. It was noted that there was positive relationship between 5S, Kaizen and organizational performance. Studies have made it clear that the 5S and Kaizen are tools that can improve organizational performance. Results showed that it was more difficult to implement Kaizen compared to implementing 5S. The most difficult thing to implement Kaizen is associated with the management. While the hardest thing to implement 5S is determining cleanliness in perpetuity. The successful implementation of 5S and Kaizen is not completely dependent on the number of years of operation, number of employees and sales turnover. Success or failure in the implementation of 5S and Kaizen for excellence in organizational performance is greatly influenced by top management commitment. This is in line with the views of some researchers 5S and Kaizen (Asaad, Saad, & Yusoff, 2012; Asaad, ZienYusoff, & Sanuri, 2013; Oki, 2012; Okoro & Singh, 2010). Commitment from the top management is one of the most important factors in organizational culture (Stone & Chermack, 2010; Testani & Ramakrishnan, 2010). However, with strategic emphasis and understanding of the criteria for the success of an organization, it will be able to establish a good organizational culture and achieve excellence in organizational performance. This study focuses on the 5S and Kaizen as one of the lean tools, which can be developed for future research to examine the level of implementation for the other lean tools relation to the performance of the organization.

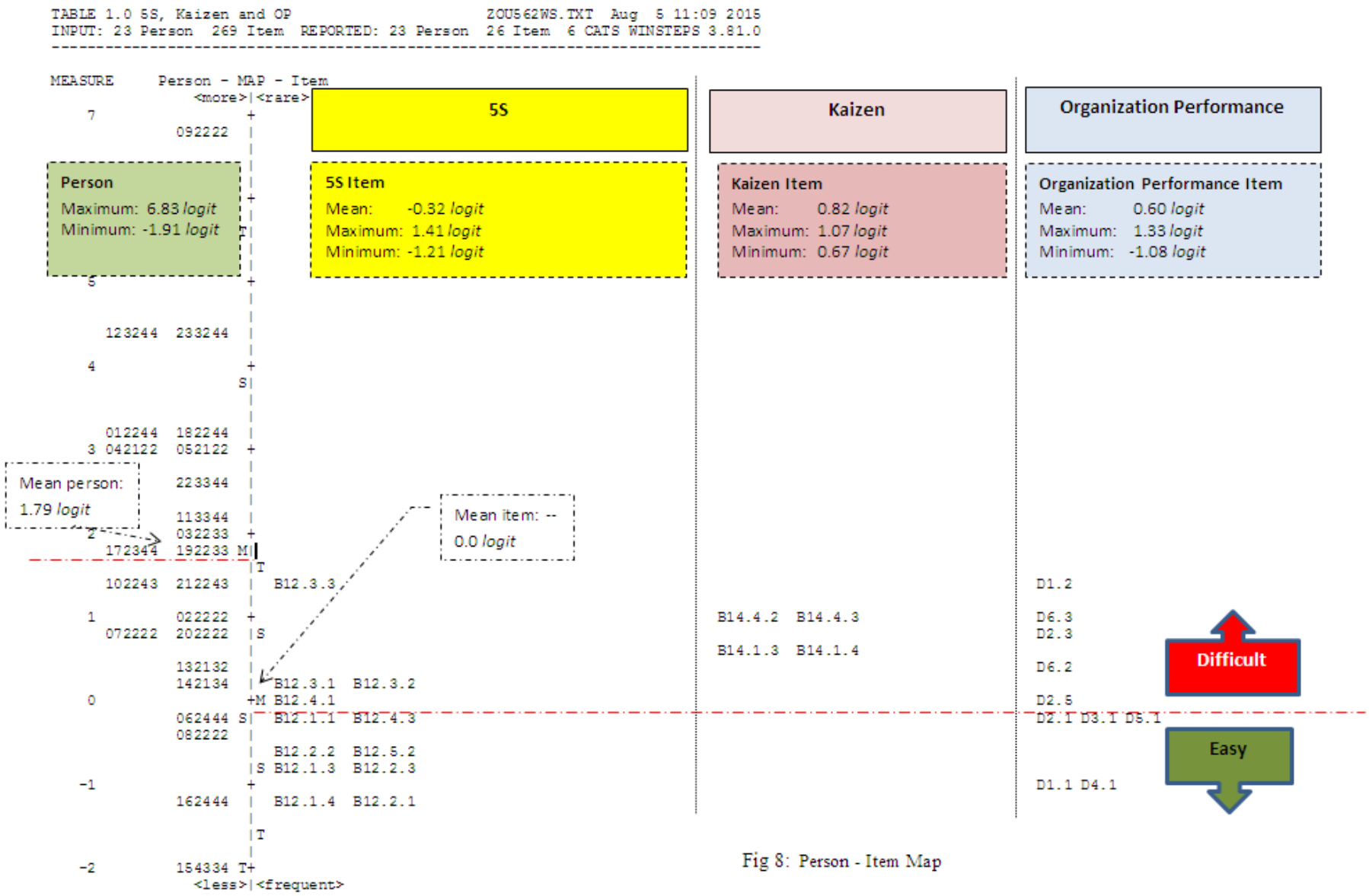

Fig 8: Person - Item Map

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