UTM
UNIVERSITI TEKNOLOGI MALAYSIA

UTM Razak School of Engineering and Advanced Technology

Proceedings of the 1st Master Project Symposium on Engineering Business Management

Editors:
Dr. Nor Raihana Mohd Ali
Dr. Habibah @ Norehan Hj. Haron
Dr. Samira Albati Kamaruddin
Dr. Shamsul Sarip

utmrazakschool.utm.my

PROCEEDINGS OF THE 1st MASTER PROJECT SYMPOSIUM ON ENGINEERING BUSINESS MANAGEMENT

13 – 15th DECEMBER 2016
UNIVERSITI TEKNOLOGI MALAYSIA
KUALA LUMPUR

ISBN 978-967-13383-4-6

Published by:
UTM Razak School of Engineering and Advanced Technology
Universiti Teknologi Malaysia
Level 7, Razak Tower
Jalan Sultan Yahya Petra, 54100 Kuala Lumpur
MALAYSIA
http://razakschool.utm.my

First Printing, April 2017
Printed in Malaysia

Editors:

Dr. Nor Raihana Mohd Ali
Dr. Habibah @ Norehan Hj. Haron
Dr. Samira Albati Kamaruddin
Dr. Shamsul Sarip

Associate Editors:

Dr. Fatimah Salim
Dr. Hayati @ Habibah Abdul Talib
Dr. Mohd Nabil Muhtazaruddin
Dr. Rahimah Muhamad
Dr. Roslina Mohammad
Dr. Sa'ardin Abdul Aziz
Dr. Sharifah Alwiah Syed Abd. Rahman
Dr. Siti Armiza Mohd Aris
Dr. Siti Zura A. Jalil @ Zainuddin

About Master Project Symposium

The 1st Master Project Symposium was held on 13-15 December 2016 for Semester 1 Session 2016/2017 at Menara Razak, Universiti Teknologi Malaysia (UTM) Kuala Lumpur. This symposium is organized every semester by Master Project Committee, UTM Razak School of Engineering and Advanced Technology to fulfil the requirement of Master of Engineering Business Management.

This symposium aims to provide a platform for students to share their research processes and outcomes among UTM Razak School members and at the same time receive inputs from the audience to improve their research. Students are exposed to various engineering business management issues by identifying the current issues in their workplaces and addressing the issue through their research.

The papers presented in the symposium are compiled into proceedings to share the research conducted by the students and findings that relates to the current practices of many of the industries in Malaysia. An index of keywords from all papers is included at the end of the proceedings. All participants and readers can enjoy reading the proceedings and gain inspirations for further research and application into education and practice.

Contents

Applying Lean Concepts in Reducing Patient Waiting Time at a Private Hospital in Ipoh

Anne Camilla [a] *and Habibah Norehan Haron*[b]

UTM Razak School of Engineering and Advanced Technology, Jalan Sultan Yahya Petra, Universiti Teknologi Malaysia, 54100 Kuala Lumpur, Malaysia
[a]*anne.camilla88@gmail.com,* [b]*habibahharon.kl@utm.my*

Abstract – *Patient waiting times has been considered a serious issue in many health care systems. It leads to patient dissatisfaction, poor medical services and ultimately influences the patient's loyalty to the hospital. Therefore this study will identify the factors causing the long patient waiting time the hospital and will develop and propose improved procedures to overcome this issue of patient waiting time. For this study, a mixed mode method which incorporates quantitative and qualitative data collection and analysis methods is used. The research objectives of this study is achieved by applying lean concepts such as value stream mapping, Ishikawa diagram, root-cause analysis and value added analysis. After various observation and analysis, it is recommended that to reduce patient waiting, a few improvements are to be implemented. The recommendations are an integrated Hospital Information System (HIS), purchasing new tools to ease execution of task, rearrangement of the department for lesser movement, redefining the express lane, improving staff allocation, purchasing of new office facilities and to encourage and create the sense of urgency in each staff so that work can be executed at a fast pace without delay.*

Keywords: Patient Waiting Time, Value Stream Mapping, Pareto Chart, Multiple Pill Cutter

1.0 INTRODUCTION

Long waiting time is a worldwide phenomenon in many sectors especially the service sector. It has been suggested that waiting time is the most important determinant of patient satisfaction. And waiting time statistics have become an important standard by which health care is measured [1, 2]. The definition of patient waiting time for this study is defined as the time from the patient arrival until departure from the hospital. Two measurements of waiting time adopted in this study: physician waiting time (defined as the time from registration until medical consultation) and total waiting time (defined as the difference between total visit time and the duration of medical service) [3].

Some of the issues found from previous journals and articles were such as improper planning and scheduling system [5, 6, 7], high volume of patients [8], shortage of staff and lack of equipment [9,10], complicated and unorganized work process [12], inappropriate design of clinic workflow and patient flow [11] and unpunctuality of patient, staff and physicians [6, 7]. Moving forward towards better service quality especially in terms of waiting time, reducing wastes and non-added value activities are lean concepts to be applied in the healthcare sector [4]. Lean concepts are is effective in identifying and eliminating waste from any process as well as reducing wait times and unnecessary travel, while building quality, speed, and flexibility into the organization. Some of the techniques involved are six-sigma [10, 12], value stream mapping [9, 13] and root cause analysis [14]. Long patient waiting time is

experienced at various departments at the hospital and is causing patient dissatisfaction. Therefore this study will identify the factors causing the long patient waiting time in a private hospital in Ipoh and will develop and propose improved procedures to overcome this issue of patient waiting time

2.0 METHOD

The objective of this study was accomplished in four stages. The sampling population of this study include outpatients visiting the specialist physician clinic and other related medical services such as pharmacy, radiology department, laboratory and ECG. The data collection was done in stages as below:

Stage 1: From the patient volume statistics obtained from the hospital statistic document the specialist physician clinic with the highest volume of patient is determined through a document analysis.

Stage 2: The patient flow from the specialist physician clinic with the highest volume of patient to various medical services at the hospital was studied. The sample size was determined using Krejcie and Morgan table with a 5% margin of error and a confidence level of 95%. The waiting time was measured using a stopwatch and recorded on an observation sheet. A pareto chart and also a main effect plot was used to determine the area to further focus the study. Hence, the department contributing to the highest waiting time was selected.

Stage 3: A value stream mapping technique was used to map out the internal tasks, value added time and non-value added time of processes at the selected department. From a pilot study of 30 cycles, the number of cycle time measurements (n) was calculated using a formula in figure 2.0 [15]. The process time for each task and the idle time between tasks was measured using a stopwatch and recorded on an observation sheet. The results of analysis reveal the causes of delay in the internal tasks which ultimately contributes to the long patient waiting time at the selected department

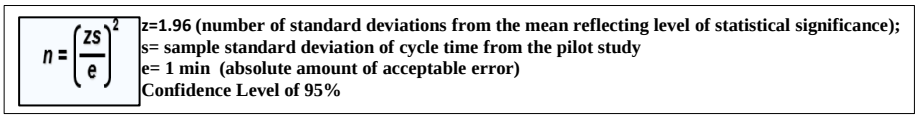


Figure 1: Number of cycle time

Stage 4: Focus group discussions, hospital policy documents and secondary data were used to develop a proposal of improved procedures and methods.

3.0 RESULTS AND DISCUSSION

Stage 1: From hospital statistics, the consultant physician specialists have the highest volume of patients and from this various consultant physician clinics; the geriatrician/physician specialist has the highest volume of outpatients. The average volume of patient per month is 926 patients. The clinic operates from 8am till 5pm on Monday to Friday and from 8am till 1pm on Saturdays. There are 2 clinic clerks and 1 nurse. Majority of the patients at this clinic are above the age of 50 years.

Stage 2: A sample of 300 patient's flow was observed for 30 days and to ensure the accuracy of the data, the sample size of 300 patients was divided equally. Each day the flow of 10 patients are observed whereby 5 patients are observed from 8am till 1pm and another 5 patients are observed from 2pm till 5pm. Six different patient flows was identified as shown in Figure 2 and the corresponding average total waiting time, average total cycle time and breakdown of the percentage waiting time are shown in Table 1.

Flow A: Physician clinic → Pharmacy
Flow B: Physician clinic → XRAY → Physician clinic → Pharmacy
Flow C: Physician clinic → CT SCAN → Physician clinic → Pharmacy
Flow D: Physician clinic → Ultra Sound → Physician clinic → Pharmacy
Flow E: Physician clinic → Pharmacy → LabTest
Flow F: Physician clinic → Pharmacy → ECG → Physician clinic → Pharmacy

Figure 2: Types of patient flow

Table 1: Average Cycle Time, Average Waiting Time and Percentage Waiting Time Department for Various Flow Type

Flow Type	Average Total Cycle Time (sec)	Average Total Waiting Time (sec)	Total Percentage of Waiting Time (%)	Percentage Waiting Time at Physician Clinic (%)	Percentage Waiting Time at Pharmacy (%)	Percentage Waiting Time at Radiology Dept. (%)	Percentage Waiting Time at Laboratory (%)	Percentage Waiting Time at ECG Room (%)
A	3320.37	2580.00	77.70	36.14	41.56			
B	5787.70	4620.00	79.82	22.81	23.84	33.17		
C	8681.27	6420.00	73.95	15.21	15.90	42.85		
D	9630.45	5950.00	61.78	13.19	14.33	34.27		
E	2021.29	1109.00	57.87	50.46	3.00		4.41	
F	4189.23	2803.00	66.91	31.99	32.94			1.98

Based on Table 1, the Pareto chart in Figure 3 is constructed showing the percentage of waiting time from highest to lowest. Hence applying the Pareto 80/20 rule, it shows that Flow A, B, C and F are the vital 20% causing 80% of the high patient waiting time. From Flow A, B, C and F the medical service involved are physician clinic, pharmacy, XRAY, CT SCAN and ECG.

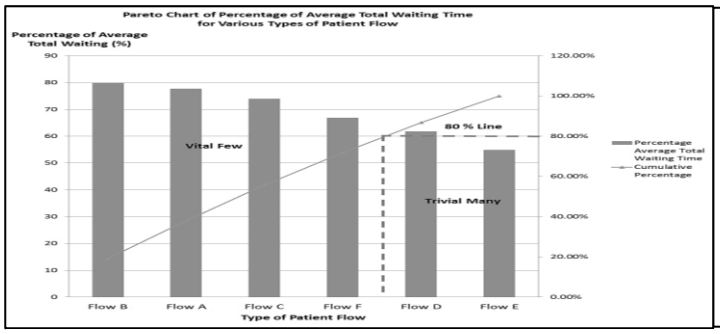


Figure 3: Pareto Chart of Percentage Average Total Waiting Time for Various Types of Patient Flow

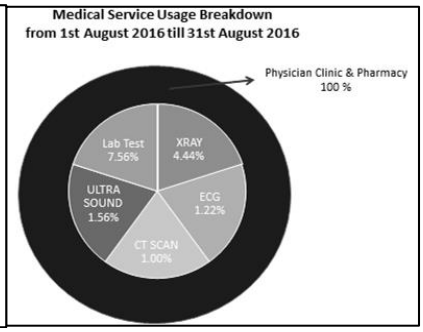


Figure 4: Medical Service Usage Breakdown

Figure 4 shows the medical service usage breakdown by percentage. From the pie chart, the physician clinic and the pharmacy has 100% of usage as the main reason for

the patient's visit is to consult a physician and the patient will end up at the pharmacy one way or rather either for payment or for collection of medication. Hence these are the two services which are highly important. The pie chart also shows that from the total patients, 8% goes for a lab test, 4% for XRAY, 1.56% for ULTRA SOUND, 1%for CT SCAN and 1.22% for ECG.

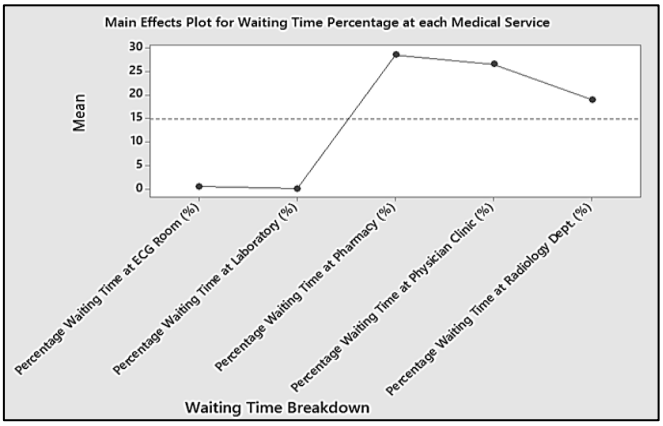


Figure 5: Main Effects Plot for Waiting Time Percentage at each Medical Service

The main effects plot in Figure 5 shows the medical service causing the highest waiting time mean is the pharmacy. Hence by considering the Pareto chart, the Pie Chart and also the main effects plot, this study will focus to identify the cause of waiting time at pharmacy and to further recommend improvements. The decision to focus on the pharmacy is made because the usage of the pharmacy service is present in the vital few patient flows and also from the medical usage pie chart, it shows 100% usage of the pharmacy and also the waiting time at the pharmacy is has the highest mean compared to all other medical service. The XRAY, CT SCAN and ECG are not the main focus even though the waiting time is highest in their respective patient flow because the usage of this medical service is a small percentage.

Stage 3: The outpatient segment in the pharmacy consists of 12 staffs working inside the medicine preparation area and 3 staffs working as cashiers for payment. The tasks involved in the pharmacy are registration, order-entry, packing, checking, payment and dispensing out the medication to patients. The peak hours at the pharmacy are from 10.00am till 1.30pm and from 3.30pm till 5pm.

The pharmacy has an average of 5000 patients in a month. The pharmacy has implemented a queue management system and also uses a hospital information system called TRACKCARE. The current standard time for the pharmacy is 15 minutes for 2 medications and below and 25 minutes for 3 medications and above. The current KPI is to meet 85% of the standard time per month. This KPI excludes tablets that need to be cut, creams and other medication which needs on the spot mixing as prescribed by the doctor.

From a pilot study of 30 cycles and using the formula in figure 2.0, 84 cycles of observation was deemed sufficient. The 84 cycles were divided equally for duration of 6 days in one week which is from Monday till Saturday. Each day 14 cycles are

observed whereby 7 cycles from 8am till 1pm and another 7 cycles from 2pm till 5pm. Except for Saturdays, since the pharmacy only works from 8am till 1pm, all the 14 observation is taking during this time. The value stream map for the workflow of the pharmacy is shown in Figure 6.

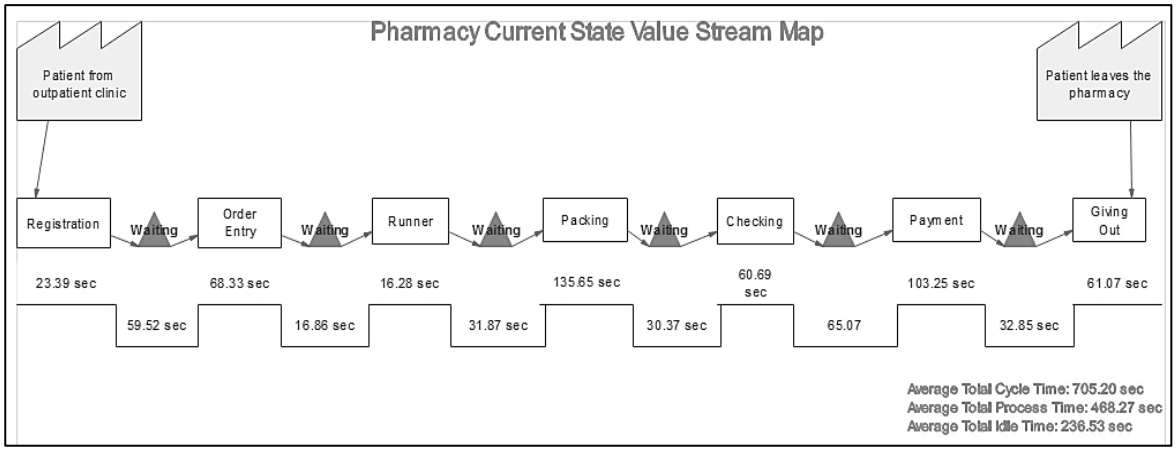


Figure 6 : Value Stream Map of Pharmacy Workflow

From Figure 6, it is analysed that the total idle time 33.54% out of the entire process cycle of the pharmacy. The task which mainly contributes to this idle time is payment and order entry which makes up 17.67% of the total idle time. The total process time is 66.46%, whereby the tasks which consume 50% of the process time are packing, payment, order entry and giving out medicine to patients. The non-value added time is defined as the time the prescription is idle between tasks and also tasks which can be eliminated while not disrupting the pharmacy flow. After performing a value added analysis and a discussion with pharmacy management team, the non-value added tasks which could be eliminated are registration and order entry but an integrated IT system would be needed to function if these two tasks are eliminated. From all the observation done, a root-cause analysis is performed to identify the causes for the long patient waiting time at the pharmacy. The causes shown in Table 2 are related to man, machine, method, material, and environment.

Table 2 : Cause derived from Using Ishikawa Diagram

Material • Pill Cutting Tool only cuts one pill at a time • Difficulty in reading certain prescription	**Manpower** • Insufficient staffs due to staff on leave • Staff lack sense of urgency especially for express lane • Staff lack awareness on order of queue numbers • Staff at Order Entry and Registration lack coordination
Machine • Computer System Hang/ Processing Speed Slow • No Integrated system between clinics and pharmacy • Printer breakdown/out of alignment • No Automated Tablet Counter	**Environment** • Interruptions from the staffs of clinic • Poor signage visibility on counter for payment only/with prescription • Pharmacy layout requires a lot of movement of staff to complete certain tasks
Method • Pharmacy and Cashier separate registration of patient. • Clarification with doctor takes time • No separate Order Entry for express lane • Allocation of staffs at various tasks during • Uneven workload between express lane and	

hospital is an integrated hospital information system (HIS). During the focus group discussion, the redundancy of registration procedure was highlighted. Each time the patient arrives at a different department, the patient needs to register and this is due to no integrated HIS. Apart from that, according to secondary data, this system will enable clinics and the pharmacy to be linked and the physician will be able to key in the prescribed medication straight into the system and pharmacy can view the prescription.

This will not only decrease patient waiting time at the pharmacy but it will also simplify the workflow at the pharmacy. The pharmacy will be able to eliminate the registration task and order entry task and concurrently carry printing label and runner task as shown by the future state value stream map in Figure 7 and corresponding time and manpower reduction shown in Table 3. The pharmacy can reduce their manpower by 2 staffs and reduce the cycle time by 21%.

Table 3: Proposed time and manpower reduction

	Task	**Process Time (sec)**	**Idle Time (sec)**
Current Value Stream	Registration	23.39	NIL
No. of Staff: 4	Order Entry	68.33	59.52
	Runner	16.28	16.86
	Total	**108**	**76.38**
Future State Value Stream	Registration	NIL	NIL
No. of Staff: 2	Order Entry	NIL	NIL
	Printing & Runner	36.28	NIL
	Total	**36.28**	**0**
Staff Reduction: 2	**Total Cycle Time Reduction: 148.10 sec**	**Process Time Reduction: 71.72**	**Idle Time Reduction: 76.38**

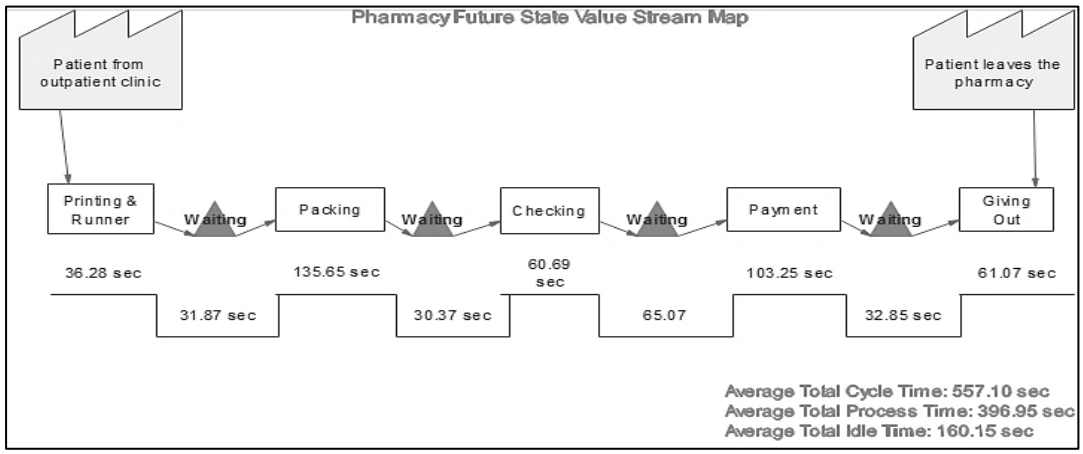


Figure 7 : Future State Value Stream Map of Pharmacy Workflow

The focus group discussion pointed out that a lot of time is consumed during packing task when the medication prescribed is instructed to be cut into half or quarter. The pill cutter used by the pharmacy currently only cuts one tablet at one time. Hence according to secondary data it is recommended that the hospital purchases a pill cutter which cuts multiple pills at a time. Group discussion also brought up the need to purchase a new printer as the current dot matrix printer used to print out the label for the medication is slow and frequently experience breakdown and out of alignment.

Staffs waste time while waiting for the printer to function or to align the printer which ultimately affects patient waiting time at the pharmacy.

Apart from that, the pharmacy management team needs to improve allocation of staffs in order to adhere to hospital policy of the pharmacy KPI. In fact from the focus group discussion, it was stated that, the KPI has not changed for several years and that implies that the pharmacy has not improved its KPI for standard waiting time. Therefore, for the express lane and non-express lane especially during days when they are short of manpower, priority needs to be given to the express lane at all times with proper allocation of staffs. The workload for the express lane and the non-express lane needs to be redefined in order to balance out the patient waiting time. Currently the express lane is for prescription with 2 medications and less but it is suggested that the express lane be redefined for prescription of 3 medications and less.

Focus group discussion raised the issue of movement of the staffs from one task to another. Especially from checking task to payment task and also at payment the cashier movement is not a smooth flow it requires cashier to walk back and forth to their place. Apart from that, the cashier counter at the pharmacy and the counter where the medication is given out to patient are not side by side and this requires patient to pay at one counter and queue at another counter just to receive their medication. Figure 8 shows the current pharmacy arrangement and the recommended arrangement. The blue arrows and red arrows in the diagram indicate the staff's movement. The "g" and "c" represents "giving out counter" and cashier counter". Hence it shows that when the giving out counter is assigned to the cashier counter beside, the staff movement is less and this will reduce the time taken to execute their tasks.

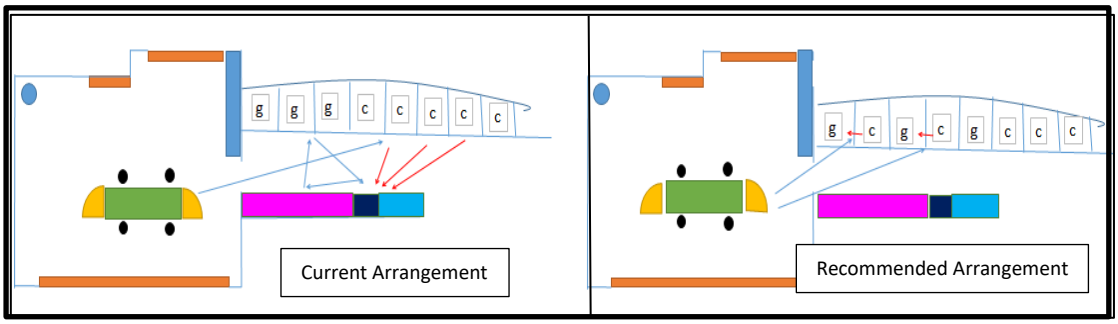


Figure 8: Current pharmacy arrangement and the recommended

Lastly, it is the policy of the hospital and its staff to provide services that conform to the requirements of our customer and to deliver them in a timely manner without any shortfall in Quality. Therefore it is recommended that the pharmacy management team encourages staffs to have a mind-set with a good sense of urgency. Currently staffs lack the sense of urgency to complete a prescription and this leads to staffs working at a very leisure pace. It is recommended that every day one staff is appointed as the supervisor in charge of driving other staffs to work at a fast pace in order to serve the patient without having them to wait long. By doing this every staff will get a chance to create this sense of urgency within themselves in order to deliver service to patient in a timely manner.

4.0 CONCLUSION

In conclusion, the hospital's pharmacy was identified to be the department which contributes the most to the long patient waiting time and patient dissatisfaction. The patient waiting time can be reduced with the implementation of an integrated Hospital Information System (HIS), purchasing new tools to ease execution of task, rearrangement of the department for lesser movement, redefining the express lane, improving staff allocation, purchasing of new office facilities and to encourage and create the sense of urgency in each staff so that work can be executed at a fast pace without delay. This study also shows that application of lean concepts with the use of value stream mapping, ishikawa diagram, root-cause analysis and value added analysis was proven to be useful in identifying the waste in the patient flow and the department workflow and further reducing the waiting time in delivery of service and to even support the administration and management of the hospital.

REFERENCES

[1] Su, Heidi Y., and Peter H. Sykes. "Waiting times for gynaecological cancer surgery." *The New Zealand Medical Journal (Online)* 122, no. 1305 (2009).

[2] Kawakami, Jun, Wilma M. Hopman, Rachael Smith-Tryon, and D. Robert Siemens. "Measurement of surgical wait times in a universal health care system." *Canadian Urological Association Journal* 2, no. 6 (2008): 597.

[3] Chen, Bai-lian, En-dong Li, Kazunobu Yamawuchi, Ken Kato, Shinji Naganawa, and Wei-jun Miao. "Impact of adjustment measures on reducing outpatient waiting time in a community hospital: application of a computer simulation." *Chinese Medical Journal (English Edition)* 123, no. 5 (2010): 574.

[4] Rexhepi, Lura, and Priti Shrestha. "Lean Service Implementation in Hospital: A Case study conducted in "University Clinical Centre of Kosovo, Rheumatology department"." (2011).

[5] Miller, Richard, and Nirisha Chalapati. "Utilizing lean tools to improve value and reduce outpatient wait times in an Indian hospital." *Leadership in Health Services* 28, no. 1 (2015): 57-69.

[6] Zhu, Zhecheng, Bee Hoon Heng, and Kiok Liang Teow. "Analysis of factors causing long patient waiting time and clinic overtime in outpatient clinics." *Journal of Medical Systems* 36, no. 2 (2012): 707-713.

[7] Rohleder, Thomas R., Peter Lewkonia, Diane P. Bischak, Paul Duffy, and Rosa Hendijani. "Using simulation modeling to improve patient flow at an outpatient orthopedic clinic." *Health care management science* 14, no. 2 (2011): 135-145

[8] Manaf, Noor Hazilah Abd. "Patient satisfaction in outpatient clinics of Malaysian public hospitals: an empirical analysis." IIUM Journal of Economics and Management 14, no. 1 (2006): 81-110.

[9] Haron, Siti Haizatul Aishah, and Rohaizan Ramlan. "Patient Process Flow Improvement: Value Stream Mapping." *Journal of Management Research* 7, no. 2 (2015): 495.

[10] Kim, Yu Kyung, Kyung Eun Song, and Won-Kil Lee. "Reducing patient waiting time for the outpatient phlebotomy service using six sigma." *The Korean journal of laboratory medicine* 29, no. 2 (2009): 171-177.

[11] Chand, Suresh, Herbert Moskowitz, John B. Norris, Steve Shade, and Deanna R. Willis. "Improving patient flow at an outpatient clinic: study of sources of

variability and improvement factors." *Health care management science* 12, no. 3 (2009): 325-340.

[12] Gijo, E. V., and Johny Scaria. "Reducing rejection and rework by application of Six Sigma methodology in manufacturing process." *International Journal of Six Sigma and Competitive Advantage* 6, no. 1-2 (2010): 77-90.

[13] Lummus, Rhonda R., Robert J. Vokurka, and Brad Rodeghiero. "Improving quality through value stream mapping: A case study of a physician's clinic." *Total Quality Management* 17, no. 8 (2006): 1063-1075.

[14] Nursing Times 16.04.13/ Vol 109 No 15 .www.nursingtimes.net

[15] Naidoo, Logandran, and Ozayr H. Mahomed. "Impact of Lean on patient cycle and waiting times at a rural district hospital in KwaZulu-Natal: original research." African Journal of Primary Health Care and Family Medicine 8, no. 1 (2016): 1-9.

Lean Implementation in Aircraft Turnaround Time

Kishen Vythinathan[a] *and Sha'ri Mohd Yusof*[b]

UTM Razak School of Advanced Engineering and Technology Universiti Teknologi Malaysia, 54100 Kuala Lumpur, Wilayah Persekutuan Kuala Lumpur, Malaysia
[a]*kishen.vythinathan77@outlook.com,* [b]*shari@utm.my*

Abstract – *"Lean" is a well-known business model with proven reputation in diverse division of the business field. It is an applied approach and well-ordered strategy that results work tasks in an operation to be executed with the minimal entanglement of non-value adding activities substantially resulting in reduced waiting time, process time, motion time, operation time, and other delays. This paper addresses the execution of Lean Maintenance in an airlines company AirAsia. The fundamental objective of this method is to reduce non-value waste during an aircraft turnaround. Important data was derived from direct observation and interviews conducted with engineers and technicians related to engineering and maintenance unit. This study demonstrates the utilization of Value Stream Mapping (VSM) in detail and means to outline the value flow and non-value adding processes and to provide recommendations for improvement. By distinguishing the waste and its sources, the current and future states of value stream maps are constructed to enhance the turnaround process. This enhancement technique focuses the advantages of lean maintenance approach in different phases of AirAsia Bhd and resulted in 11.9 minutes reduction in process duration and increment in cycle efficiency is ensured. The flow process or cycle time was improved therefore minimizing various non-value added activity and time such as waiting time, motions, over processing and so on. It can be concluded that VSM is a productive instrument for distinguishing waste within process and to eliminate them. Therefore, organizations of similar type can utilize this exploration results as a learning base to recognize their wastes and come up with appropriate solution.*

Keywords: Lean Maintenance, Value Stream Mapping, Cycle time

1.0 INTRODUCTION

According to Airbus S.A.S [1], over the past decades, airlines industry has shown a continuous growth as air transportation has doubled every 15 years with an average annual air traffic growth rate of 4.6%. It is expected that air transportation will keep growing in the future mainly caused by the growth of Low Cost Carriers (LCC) airlines. A study by Karunakaran [2] states that in the coming years, the competition will only become fiercer due to the increase in the number of airlines in the market. In order to build market share in these hard conditions, the customer needs to be satisfied. Jeyaraj and his co-workers [3] stated that from a lean perspective, customer satisfaction is based on three main items; costs, time and quality. Thus, by decreasing the turnaround time while maintaining repair quality and lowering expenses, is the way the airlines may be able to gain the most value. A study conducted by Ahmat and his co-workers [4] shows that a reduction in turnaround time could have multiple advantages for airlines: expenses could be spared due to higher utilization rates of aircraft. Another alternative may be to utilize the turnaround time to make up for lost time in arrival delay. The punctuality of the departing aircraft could be enhanced, making the particular airlines more alluring for passengers.

This research is focused on the turnaround of aircraft once landed at the airport until the aircraft is ready to depart for its next destination. Optimal planning of turnaround operations for airlines is very important since every second of the aircraft staying on the ground means the company loses profit. In that sense, the airline company having problem of not completing turnaround processes on time causes delays. Research done by FlightStats, Inc [5] demonstrates that source of delays are down to airline operations and planning which may account up to 40–50% and technical faults represent up to 20%. Delays cost money for airlines and passengers, regardless of where the delays originate from. The fundamental objective of this analysis is to develop a framework in view of lean thinking tools which will validate the relevance of lean thinking in an operational maintenance background outside the traditional discipline of manufacturing. The main question for this research is to know what is the most significant improvement can be made regarding aircraft turnaround time in terms of value added and non-value added activity.

2.0 METHODOLOGY

The project methodology aims to comprehend the present condition of the maintenance department and surrounding functions in the maintenance site. One of the primary objectives of this study was to design a future state value stream mapping (VSM) that outlined the ideal information and process flow for aircraft turnaround checks. In this study, quantitative method of observation and adopted interviews are used to collect data. The research would like to determine the characteristics of the non-value added activity factors that affect airline turnaround delays. The logic of selecting these techniques was to acquire further understanding of reasons behind the factors and furthermore, it will be helpful to acquire idea from meaningful form of information for current and future research. In this research, four steps of research were conducted. Firstly, is to highlight the non-value added activity as the issues that can causes problem in the company. The company has waste in the process because of unexpected delays. In an aircraft turnaround, if one process causes delay, then it will not be possible for the airlines to complete its promised turnaround time. In their study, Agrahari and his associates [6] came up with a conclusion that delays in turnaround can increase the company's operating cost and lower customer service level. The second step will be to analyse all the data collected during the interview and field observation session. Following the criteria, the interview data was chosen to be analysed using hand, and presented narratively with identified themes and illustrating quotes. The next step will be to develop the current value stream map. Once the map is constructed, an in-depth analysis is conducted to identify waste. This step can give result in the form of future state mapping. With that, the final step will be to develop a future value stream map based on the analysis done previously.

3.0 RESULTS AND DISCUSSION

This study was conducted at AirAsia, Malaysia where they provide low cost airline services. The result from the study will be presented in this chapter. These results are based on field observations, interviews and lean tools especially value stream map. First and foremost, the results will be grouped and analysed. Then the current state map and the future state map will be presented and the discussion on the results will show how the future state evolved and how it's motivated by above mentioned tool.

3.1 Current value stream map

The current state VSM is displayed in the figure beneath which demonstrates the turnaround process steps within AirAsia. In this current VSM mapping, the primary object to be researched is the airlines maintenance turnaround process in AirAsia, starts from the minute the aircraft lands until it take-off. Objective of this research is to enhance the turnaround time utilizing VSM, so the area research is only the line maintenance process. To design the current state value stream map, data was gathered by interviewing engineers and technicians in the maintenance unit. Process and time study was performed at the maintenance line during the line of operations. One of the outputs from this current VSM mapping is reducing cycle time by identifying waste.

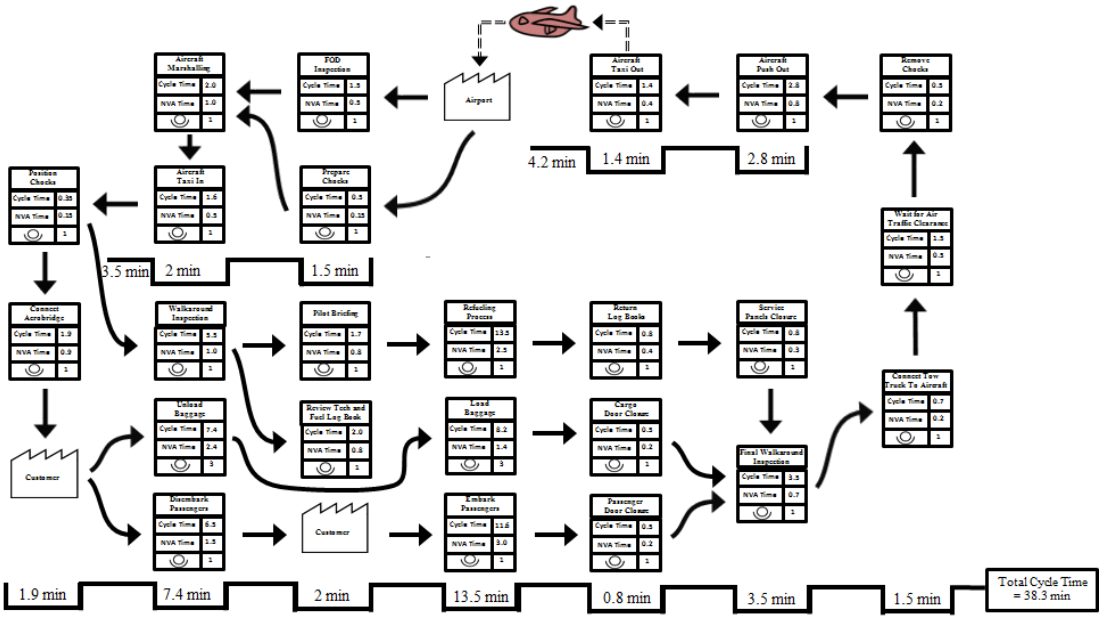


Figure 1: Current value stream map of AirAsia turnaround

After performing a time study on the Aircraft turnaround process, recorded information have been physically written onto a blank spreadsheets and then later transferred that data into the Excel program. With this data, the recorded process durations were inserted into the current state and future state VSMs, respectively. A timeline is then incorporated at the base of the map to complete the value map. As appeared in the above figure, the total cycle time is shown on the right side of the map.

The accompanying data was gathered from the turnaround process:

- process cycle time
- non-value added time
- number of operators involved

The actual reading of the process cycle time was measured using a calibrated stopwatch. A significant measure to detail was given during this process as the analysis of the process flow characteristics is the most essential and critical to develop a desirable future state. Each process duration are presented in the data boxes beneath each operation illustrates the processing time at each phrase and eventually the value

stream map for the current state is developed as appeared in the figure above. As can be seen in the figure above, the total cycle time for the whole turnaround process is 38.3 minutes which contains a total of 24 steps. Out of the 24 steps, the cycle time for the refuelling process is the longest which takes 13.5 minutes for it to complete.

3.2 Future value stream map

After a considerable amount of time analysing the current state for improvement, the future state value stream map is developed as shown in Figure 2 which reported a considerable reduction in non-value added time. The results show that 3 non-value added activities has been eliminated thus, reducing the total steps to 21 from 24 steps previously. With this a reduction in time for the whole process is also observed. Time taken now to complete the whole process is reduced from 38.3 minutes to 26.4 minutes as illustrated in Figure 2 below.

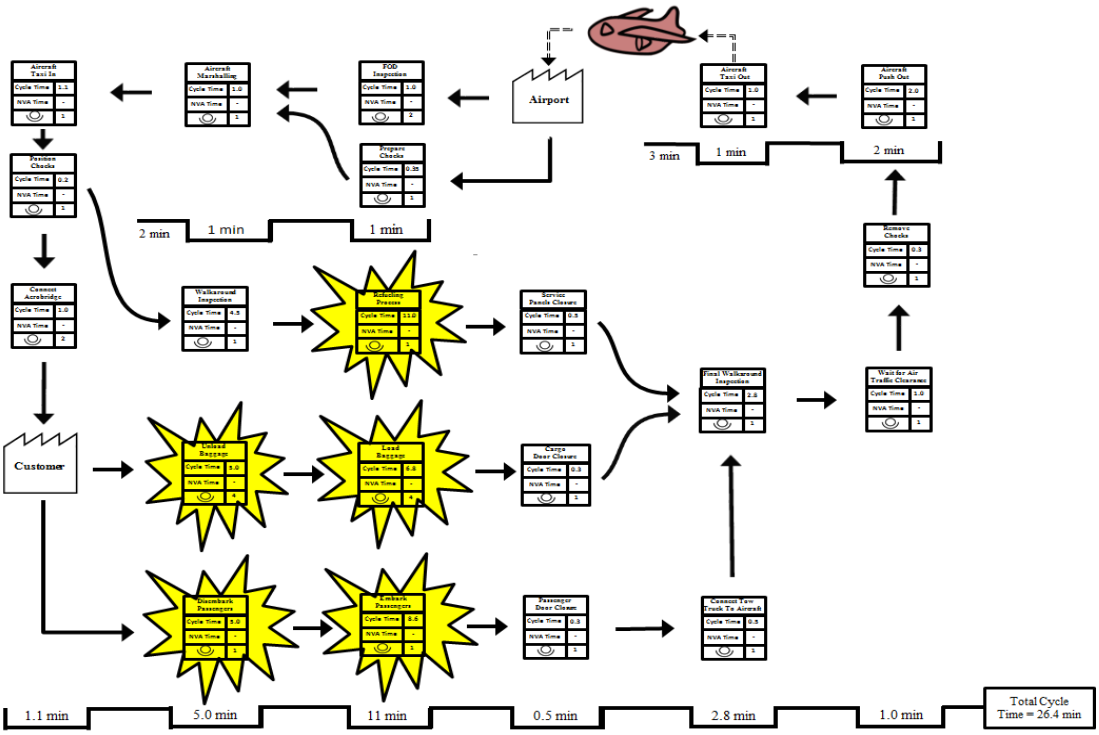


Figure 2: Future value stream map of AirAsia turnaround

Bulatovic and Djurovic [7] explained that in VSM, the current state map assist in generating a snapshot to comprehend the business operations; it demonstrates the 'as-is' circumstance of a business. Saboo and his co-workers [8] explained further that the future state VSM empowers organizations to consider looking into the future and comprehend the most ideal method of operating a value stream. To construct a future map a methodical perspective should be pursued in order to gain the utmost benefit from the VSM technique. The propositions to reduce/eliminate the problems in the turnaround process highlighted are as followed:

- The pilot briefing can be done during early stage of the process. For example the pilot shall arrive early and brief the engineers or technicians in charge during the aircraft marshaling process where the engineers or technicians will be waiting for the aircraft to park to do the visual inspection. So this activity can be done at that particular period to eliminate the waiting time (non-value added activity).
- The review technical and fuel log book activity can be eliminated if the airlines decides to use electronic system to track if there any defects to be rectified. Thus, even before the flight lands engineers and technicians will be able to prepare ahead if there is any replacement needed. This will also eliminate the process of returning the log books to the pilot, reducing non-value added activity.
- The Aircraft marshalling activity time can be reduced by replacing it with Visual Docking Guidance System. This system offers data to the pilot endeavoring to park an aircraft at an airport bay, usually via visual technique. This will make taxiing and parking process quicker and will also kill any delays brought by the aircraft marshaller for example late arrival.
- The fueling process time can be reduced if the airlines use electronic system to deal with fuel load. Calculating fuel needed for flight (NVA activity) and sending the fuel order to fuel supplier (NVA activity) steps can be eliminated.
- Closing aircraft door time also can be improved by ensuring the agent that delivers the passenger information list follows the last passenger to board the aircraft and close the door right after.
- The embarking and disembarking passenger process is a value added activity. So the only way to improve is by continuous improvement. One way of reducing time is to use 2 aerobridge instead. One at the front door to board customer from let's say row 1 to 15 and row 16 to 30 from the rear door. Another recommendation will be by using the aerobridge for passengers let's say rows 1 to 15. In rows 16 to 30 or similar, passengers go down a set of stairs off the aerobridge, walk on the tarmac and then climb stairs to the rear aircraft door.
- The baggage handling process can affect aircraft turnaround in various ways, largely the time needed for the actual unloading and back to back loading of the baggage from the aircraft. Not ignoring the pace with which all screening, sorting and transportation procedure are achieved is another vital factor. Thus, continuous improvement is the way of reducing the time. Concentrating on enhancement along the process chain, rather than maximizing performance at a particular task, can aid to overcome this.

4.0 CONCLUSION

This present study provides an analysis of improving AirAsia turnaround process by eliminating the non-value added activities using value stream map, a lean tool. Its focal point is to reconstruct the turnaround operations by eliminating the non-value added activity and improving total cycle time. Based on the empirical validation conducted, it is clear to be seen that VSM can be successfully and effectively utilised as the preliminary step of waste identification. Utilizing this tool, it is feasible to map out the current status and thereafter analyse to achieve waste elimination. This paper demonstrated that wastes such as motions, waiting time and over processing can be minimized which in turn improves the turnaround time and output of the organization. Thus, VSM helps to visualize the current level of wastes happening in the

organization and the future possibilities of reducing or eliminating them. Ayeni and her fellow comrade [9] concluded that in order to continuously reduce or eliminate waste, management of companies need to apply lean tool and techniques accordingly while giving adequate training to their employees. Moreover, Jong and his co-workers [10] supported by stating that by providing adequate training, it encourages the culture of continuous improvement directed at maintenance excellence. In general, any enhancement accomplished from executing the recommended process might take time to revamp maintenance activities into lean. Nevertheless, commitment and direct association of an organizational management alongside with employee training and teamwork development can be an impetus to accelerate the transformation process.

REFERENCES

[1] Airbus S.A.S. "*Airbus Global Market.*" (2016), Assessed 8 July 2016, http://www.airbus.com/company/market/forecast/.

[2] Karunakaran, Sreedhar. "Innovative application of LSS in aircraft maintenance environment." *International Journal of Lean Six Sigma.* (2016), 85-108.

[3] Jeyaraj, K. L., C. Muralidharan, R. Mahalingam, and S. G. Deshmukh. "Applying value stream mapping technique for production: Improvement in a manufacturing company." *Journal of The Institution of Engineers (India): Series C* (2013), 43–52.

[4] Ahmat, Muhammad Mustaqim, Md Saidin Wahab, Abd Malek Sidek, and Mohd Shahir Yahya. "Production Improvement in an Aircraft Manufacturing Company Using Value Stream Mapping Approach." *Applied Mechanics and Materials*. (2014), 1038-1042.

[5] FlightStats, Inc. "*FlightStats Global Cancellation and Delays.*" (2016), Accessed November 15, 2006. http://www.flightstats.com/go/Media/stats.do?region=asia

[6] Agrahari, Ravindrakumar, Priyanka Dangle, and Kailas Chandratre. "Improvement Of Process Cycle Efficiency By Implementing A Lean Practice: A Case Study." *International Journal of Research in Aeronautical and Mechanical Engineering.* (2015), 38-51.

[7] Bulatovic, M, and D Djurovic. "Lean concept in the maintenance." *Journal of Trends in the Development of Machinery and Associated Technology.* (2014),135-138.

[8] Saboo, Aayush, Jose Arturo Garza-Reyes, Ahmet Er, and Vikas Kumar. "A VSM improvement-based approach for lean operations in an Indian manufacturing SME." *Int. J. Lean Enterprise Research.* (2014), 42-58.

[9] Ayeni, Peter, Peter Ball, and Tim Baines. "Towards the strategic adoption of Lean in aviation Maintenance Repair and Overhaul (MRO) industry: An empirical study into the industry's Lean status." *Journal of Manufacturing Technology Management.* (2016), 38-61.

[10] Jong, Stephan J. de, and Wouter W.A. Beelaerts van Blokland. "Measuring lean implementation for maintenance service companies." *International Journal of Lean Six Sigma* (2016), 62-84.

Downtime Reduction Strategies for Wafer Fabrication Tools in the Semiconductor Industry

Kunasilan Vibinasanthirabalan[a], *Sathiabama T. Thirugnana*[b] *and Mohd Nabil Muhtazaruddin*[c]

UTM Razak School of Engineering and Advanced Technology, Jalan Sultan Yahya Petra, Universiti Teknologi Malaysia, 54100 Kuala Lumpur, Malaysia
[a]*ffv73h@onsemi.com*, [b]*sathiabama@utm.my*, [c]*mohdnabil.kl@utm.my*

Abstract - *The interest arose to do a study on reducing the equipment downtime and create strategies to assist the maintenance team. The problem faced is the high downtime of the Tegal plasma etchers which reduces the output of the dry etch product. The research is done using a mix method by collecting data from softwares (quantitative) and survey (qualitative) of maintenance procedures. The research results are good and the downtime has been reduced drastically. As a conclusion the reduction of downtime indeed plays a vital role on the manufacturing output.*

Keywords: Tegal, downtime reduction, production output, semiconductor manufacturing

1.0 INTRODUCTION

ON Semiconductor competing with other major semiconductor manufactures has led to the company to expand to its widest. The ISMF is an Integrated Surface Mount Facility that operates as a wafer fabrication plant for ON Semiconductor at Senawang, Negeri Sembilan. Acting as a wafer fabrication plant ISMF is expected to constantly provide front end organization with wafers. These front organizations stand from various manufactures and ON Semiconductor itself. Equipment downtime is inevitable in a wafer fabrication plant and a single machine down could affect the downstream production process [1].

It is critical for a plant like ISMF to be productive and efficient as it is one of ON Semiconductor's leading wafer fabrication facilities. As so ISMF has been very keen to eliminate all factors that disrupt its output performance. One of the main focuses is to reduce downtime of critical tools and improve the tool's availability [2]. This is a very complex area as downtime reduction of critical tools needs intense study that anything done does not affect the after product.

2.0 LITERATURE REVIEW

Semiconductor production is a field which is highly competitive in the manufacturing industry and market. In order to become a top company in the global market manufacturing companies should not bear any form of losses be it as raw material,

human work force or Equipment Downtime [3]. The equipment downtime is calculated by using OEE which is known as the overall equipment efficiency. Increasing the tool uptime has always been a dare to the maintenance team in the semiconductor manufacturing industry as industry gets more competitive by the day [4]. At manufacturing companies the tool uptime plays a vital role towards the production output. As the output rate increases the production tools need to be more and more reliable. Maximizing process tool uptime has remained a core challenge for the manufacturing of advanced semiconductors over time [4]. Tool uptime always determines a company's output and productivity. Maximizing tool uptime also increases the quality of the product but not having hiccups in the production process. Creating strategies to reduce downtime and improve availability of the complex equipment is very important [2]. A fixed step of downtime strategies are must in highly competitive field such as semiconductor manufacturing.

3.0 RESEARCH DESIGN

The data will be collected using Brio Query and My report software for both Tegal Tool which are the 901e and 903e. These softwares will process the downtime, availability and wafer outs of the tool. In general principle, any selected method, either quantitative or qualitative based will be considered appropriate provided that the flow of the research is guided. Therefore, the nature of the investigation itself t determines the method needed to achieve better results. Qualitative method explores attitudes, behaviour and personal vision through interviews and a focus group. By trying to get feedback from the Technicians specified which will be part of the investigation. In a paradox, quantitative method generates statistics through the use of the "Brio query" together with the assistance of the "Report Master" software. As for this reach the quantitative method will serve best as we are dealing with raw data collection from softwares and document survey.

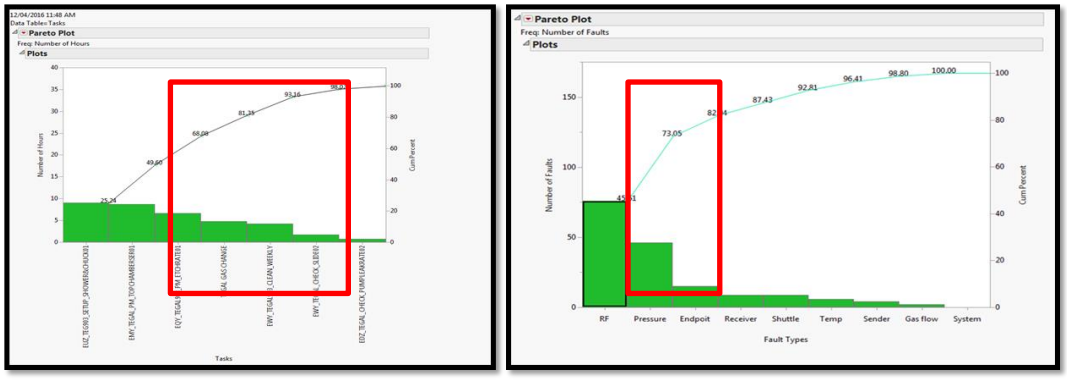


Figure 1 : The Downtime data collected and plotted into a Pareto

Figure 1 shows data collected and plotted for scheduled and unscheduled downtime for Tegal tool. The graph on the left shows us the downtime related to scheduled maintenance and left shows us the downtime related to fault and stoppages also known as unscheduled downtime. By analysing this data a list of strategies are proposed and implemented. The strategies are Tegal Top chamber service standardize

procedure (S1), Reduce Tegal Faults (S2), One stop change of Shower Head and Chuck -Single Minute Exchange of Die (S3) and Eliminate bottle gas change time (S4).

4.0 RESULTS AND FINDINGS

4.1 Tegal Top Chamber Service Standardize Procedure (S1)

Figure 2 shows the modification on the old SOP for tegal top chamber standize procedure. Additional eight new steps has been applied based on discussion with other technicians. The task management software has been used to execute the entire task.

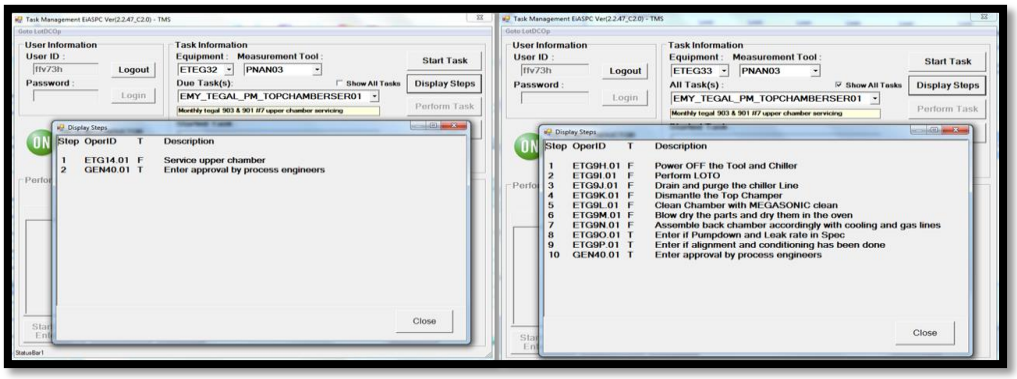
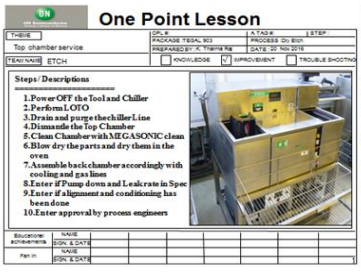


Figure 2 : The Previous Steps (left) and The Revise New Detailed Steps (right)

Figure 3 shows that the current procedure for doing the top chamber service is not listed out in detail. So a new standard procedure for the top chamber servicing task was created. There are many variables here as each and every technician has their own way of doing the procedure. Some are able to complete within 3-4 hours and some around 7-8 hours. However the end results are the same as we have a good running condition chamber.



EQPID	TASK_NAME	DATE_PM_ PERFORMED	DATE_PM_ FINISHED	DURATION
ETEG33	EMY_TEGAL_PM_TOPCHAMBERSER01	11/24/2016 16:24	11/24/2016 19:50	0 days 3.44 hrs
ETEG33	EMY_TEGAL_PM_TOPCHAMBERSER01	9/4/2016 9:37	9/4/2016 17:37	0 days 8.01 hrs
ETEG33	EMY_TEGAL_PM_TOPCHAMBERSER01	8/5/2016 14:38	8/5/2016 23:06	0 days 8.47 hrs
ETEG33	EMY_TEGAL_PM_TOPCHAMBERSER01	6/12/2016 12:13	6/12/2016 21:54	0 days 9.68 hrs

Figure 3 : The OPL and the results showing the downtime reduction.

After implementation we have come up with an OPL format and results are shown as Figure 4. Our achieved our goal is to have a total task time less than 4 hours which is almost 50% in downtime reduction.

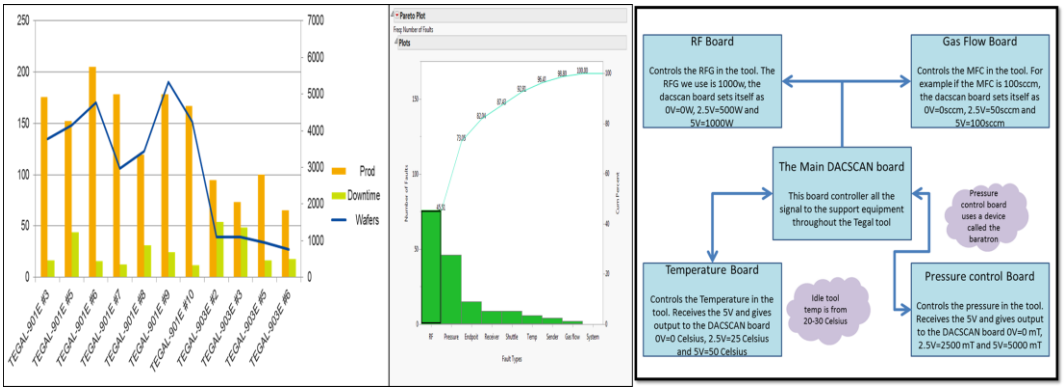


Figure 4 : The relationship between downtime (Left), output with the Pareto of Faults (middle) and the Tegal operational diagram

4.2 Reduce Tegal Faults (S2)

The Tegal tool is linked directly into a database which captures the stoppages cased bay faults into the system. From Figure 4 it is shown that more stoppages reduce the wafer outs from the tool itself. The fault data from the system has been abstracted and plotted into a Pareto. A total of 73% of faults are RF and pressure faults. Further research into the machines operation as Figure 4 showed that the 5V voltage to the tool plays a very vital role in creating faults and incomplete etch. In order to overcome this issue the 5V supply was traced and analysed. It was found that the JST connector used in all tools has been deteriorating and causing the 5V to drop. As an experimental tool ETEG15 was selected and it was fitted by a new design screw help connector. The tool was also fitted with a voltage monitor and a flow monitor. The flow monitor will monitor the chiller flow to the tool to eliminate the temp faults. It is noticed that after the implementation of strategy the faults have been reduced dramatically and in relation there are no more incomplete issues too as shown in Figure 5.

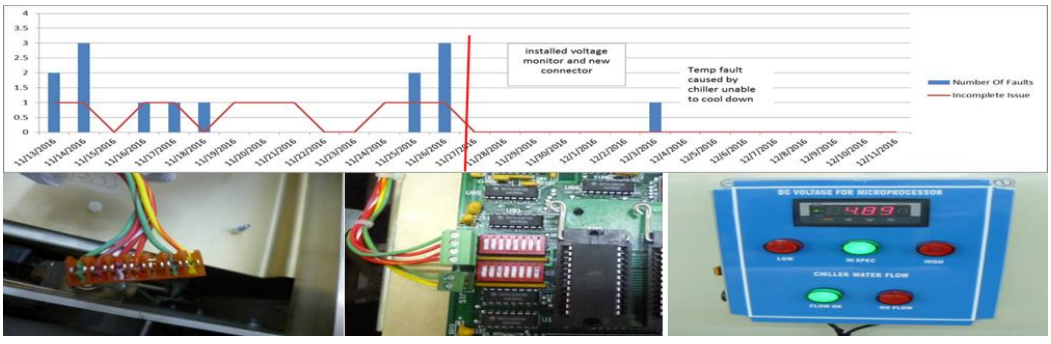


Figure 5 : Before and after downtime chart (top) the upgraded connector in green (bottom right) and the voltage monitoring system (bottom Left)

4.3 One stop change of Shower Head and Chuck (Single Minute Exchange of Die) (S3)

To survive in aggressive competition, industries need to decrease production period and costs in order to increase operating performance and flexibility [5]. Single Minute Exchange of Dies (SMED) mainly emphasises on recognition of internal and external activities as shown on Figure 6. The Chuck and shower head change task takes around an average time of 9 to 11 hours to be performed. SMED has been used on the task to separate it into external activities, internal activities and streamlining.

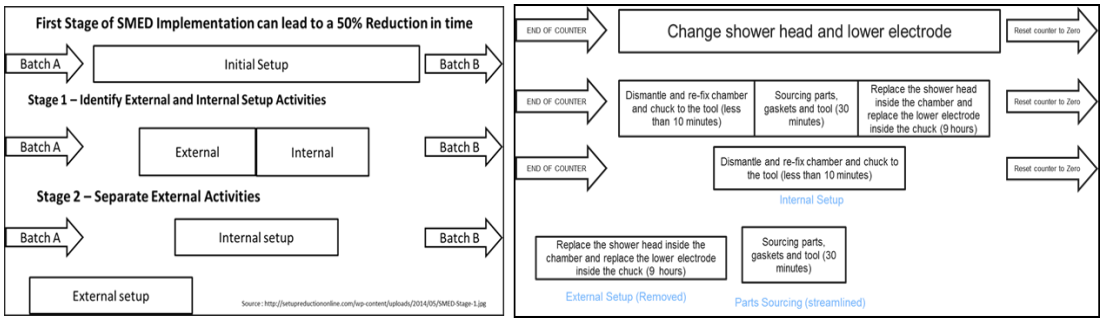


Figure 6 : SMED flow

A new organized one stop change trolley was designed which has a full model of the Chamber and lower electrode unit together with all the tools needed for the task. So, instead of change the shower head and chuck, the system has been modularized into changing the entire chamber and lower electrode. By implementing SMED the shower head and chuck change downtime has been reduced by 95% as shown in Figure 7.

EQPID	TASK_NAME	DATE PERFORMED	DURATION (hours)
ETEG33	EUZ_TEG903_SETUP_SHOWER&CHUCK01	5-Dec-16	0.28
ETEG36	EUZ_TEG903_SETUP_SHOWER&CHUCK01	23-Sep-16	8.85
ETEG32	EUZ_TEG903_SETUP_SHOWER&CHUCK01	6-Sep-16	11.05
ETEG36	EUZ_TEG903_SETUP_SHOWER&CHUCK01	17-Jul-16	7.23

Almost 95% in downtime reduction

Before implementation
After implementation

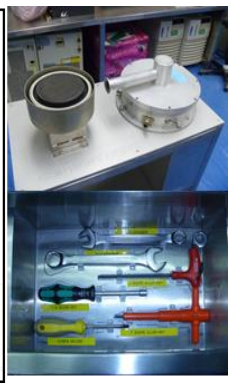


Figure 7 : The results after SMED and the one stop change trolley

4.4 Eliminate bottle gas change time (S4)

When a SF6 bottle gas of CHF3 bottle gas goes low, we need to down the Tegal to change the gas. This creates a huge amount of down time as shown in Figure 8. These charts were made from data on 5th October 2015 which is a day where gas change

occurred and data on 6th October 2015 which was a normal production day. The proposal which is currently waiting for the finance department approval is to do an auto switching system for both bottle gas supplies which are SF6 and CHF3. In average we produce 300 wafers per tool during the day of the gas bottle change. On a normal day we produce around 600 wafers per tool. That is a loss of 300 wafers per tool on the day of gas bottle change. If we could eliminate the bottle gas change entirely we will have added revenue of 3300 wafers (300 x 11) every 3 months for SF6 and 1200 wafers (300 x 4) every 4 months for CHF3 gas.

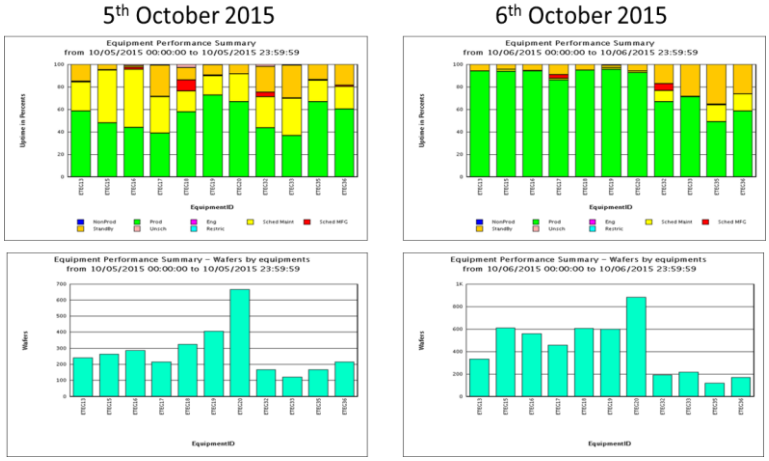


Figure 8 : Wafer output and equipment availability chart between a normal production day vs a production day involving gas change.

4.0 CONCLUSION

As a conclusion, all identified downtimes on the Tegal tool have been presented with a solution. After implementation, from the results it has been affirmative that the hypothesis made is accurate except for the auto gas switch which still awaits approval. Tegal Top chamber service standardize procedure has reduced the task downtime from an average of 8 hours to 4 hours (50% reduction), Reduce Tegal Faults strategy effective reduced most of the fault stoppages and also showed a potential elimination of incomplete etch, the One stop change of Shower Head and Chuck (Single Minute Exchange of Die) has reduced the task downtime from an average of 9-11 hours to an average of 0.28 hours (95% reduction). Reduction of downtime is the best way to bring a machine from its normal production level to its optimum production level. Reduction of downtime will lead the company to be more productive and profitable. Subsequently this creates business growth and job opportunity for our local society. Increase in productivity also eliminates the factors of company shutdown or retrenchment which itself is a great contribution to the society.

REFERENCES

[1] Tu, Ying-Mei and Chiu-Ling Chen. “Model to Determine the Capacity of Wafer Fabrications for Batch-Serial Processes with Time Constraints.” International Journal of Production Research 49, no. 10 (May 15, 2011): 2907–23. doi:10.1080/00207541003730854.

[2] Li, Bo, Feng Yang, and Daohan Zhou. “Evidence for Self-Organized Criticality in Unscheduled Downtime Data of Equipment.” Journal of Systems Engineering and Electronics 25, no. 6 (December 2014): 1020–26. doi:10.1109/jsee.2014.00117.

[3] Ahire, Chandrajit P. and Anand S. Relkar. “Correlating Failure Mode Effect Analysis (FMEA) & Overall Equipment Effectiveness (OEE).” Procedia Engineering 38 (2012): 3482–86. doi:10.1016/j.proeng.2012.06.402.

[4] Czerniak, M., A. Ifould, M. Mooney, and A. Maiorana. "Maintenance pooling to maximize fab uptime." 2012 SEMI Advanced Semiconductor Manufacturing Conference, 2012. doi:10.1109/asmc.2012.6212892.

[5] Yash Dave and Nagendra Sohani. “Single Minute Exchange of Dies: Literature Review.” Lean Thinking 3, no. 2 (December 2012): 11

[6] Chik, Mohd Azizi, Kader Ibrahim, Mohd Hazmuni Saidin, Faizah Md Yusof, G. Devandran, and U. Hashim. "Development of capacity indices for semiconductor fabrication." 2012 10th IEEE International Conference on Semiconductor Electronics (ICSE), 2012. doi:10.1109/smelec.2012.6417228

[7] Dennis, John Ojur, F. Ahmad, M. Haris Md Khir, and Nor Hisham B. Hamid. "Analysis of bonding failure in CMOS MEMS chips." 2013 IEEE Sensors Applications Symposium Proceedings, 2013. doi:10.1109/sas.2013.6493573.

[8] Nicolae (Mănescu), Raluca, Anişor Nedelcu, And Adela-Eliza Dumitraşcu. “Improvement The Quality Of Industrial Products By Applying The Pareto Chart.” Review Of The Air Force Academy 13, No. 3 (December 16, 2015): 169–72. Doi:10.19062/1842-9238.2015.13.3.29.

[9] De Mast, Jeroen and Joran Lokkerbol. “An Analysis of the Six Sigma DMAIC Method from the Perspective of Problem Solving.” IJPE 139, no. 2 (October 2012): 604–14. doi:10.1016/j.ijpe.2012.05.035

[10] Bordage, Georges. “Conceptual Frameworks to Illuminate and Magnify.” Medical Education 43, no. 4 (April 2009): 312–19. doi:10.1111/j.1365-2923.2009.03295.x.

Spares Management Impact on C130H Aircraft Serviceability

Armiee Bardan[a] and Sa'ardin Abd. Aziz[b]

UTM Razak School of Engineering and Advanced Technology, Universiti Teknologi Malaysia, Jalan Sultan Yahya Petra, 54100 Kuala Lumpur, Malaysia
[a]wdm698@gmail.com, [b]saa.kl@utm.my

Abstract – *The purpose of this study is to carry out analysis on the conventional spares management system practiced by Royal Malaysian Air Force (RMAF) that affect aircraft serviceability. This study focuses on the 10 critical components of Hercules C-130H aircraft. Monthly Organization Report (MOR) on year 2014 reported that the aircraft serviceability percentage is low and does not meet operational requirements. As a result, there are few components installed on the aircraft is not reliable and has caused recurring defect eventually resulted in the Aircraft on Ground (AOG) and Awaiting Parts (AWP). Therefore, it is a necessity to find out the cause of AOG/AWP through the time taken on Repair Turnaround Time (RTAT) that affects the aircraft serviceability and readiness. The results of this study could eventually determine whether the current spares management system practiced by RMAF is efficient or otherwise. The findings is believed be able to verify the weaknesses of the current spares management system in order to reduce the RTAT consequently increasing the aircraft serviceability percentage. The findings are significantly an advantage to RMAF in order to achieve high percentage of aircraft serviceability, availability and sustainability.*

Keywords: Spares Management, Aircraft, Services, C130H, Repair

1.0 INTRODUCTION

RMAF entity is established on 16 September 1963 during the formation of Malaysia. The vision of the RMAF is to be the dominant air power and its' mission is to defend national sovereignty and interest through effective use of air power [1]. In achieving the mission and vision, which is to defend the air space through dominant power, RMAF needs effective and efficient logistic supports. This study is focus on conventional spare management system practiced by RMAF but concentrate on the components that contributed to the failure of the No 20 Squadron operational duties. MOR plays role as the base of the operation management failure. MOR report shows that the percentage of Hercules C-130H aircraft in the No 20 Squadron was not achieve the Quality Objective target as stated in the Engineering Quality Manual which is "To ensure 70% of availability of total aircraft fleet"[2]. In addition, the average Operational Availability (Ao) for the year 2014 is 64.7%.

The main factor of the Quality Objective could not be achieved was due to the frequency of defect and time taken to rectify the aircraft. The time taken to rectify the aircraft is divided into two categories which are In Work (IWRK) and Aircraft on Ground (AOG). The term IWRK refers to the time period taken by the technician to rectify the defect of the aircraft from the beginning until the aircraft rendered serviceable. Meanwhile, the term of AOG refers to a period of waiting time for the components or spare parts from the beginning until the receipt of the spares or components. The downtime period of the aircraft will be long if the waiting process of the component is still in AOG status.

The process of a waiting component is divided into two categories namely "Available" and "Nil Stock". For the components or spare parts that are available in stock, the length of the waiting time only involves the process of application and delivery to the squadron. The range of time from the raise a demand until its approval is between 2 to 72 hours. On other hand, the length of time may take longer for the Nil Stock status. This is due to the involving of the extra process, namely the process of buying (for consumable items) or repair (for components). The time range for the approval of the components and spare parts for the Nil Stock status is between 10 days to 365 days. The components repair process that applied by RMAF includes 3 levels of processes. The first level is the repairing process by unit level where the repair costs is below than RM 50,000. The second level is the repair process under the supervision of Markas Pemerintahan Bantuan Udara (MPBU) where the cost of repair is above RM50,000. Normally, the repair can only be carried out by an authorized local contractors approved by RMAF and Original Equipment Manufacturer (OEM).

This research is discussed in deeper regarding to the conventional spare management system practiced by the RMAF. It is important for the RMAF to lowering the AOG percentage in order to increase the Ao percentage of the Hercules C-130H aircraft. The high percentage of AOG reflects the weaknesses of the spare management system practiced by the RMAF. In order to achieve the three primary components, the military aviation operator must have an efficient spares management system and good connection with the service parts suppliers [3]. The component repair processes that applied by RMAF includes 3 levels of processes as shown at Figure 1.

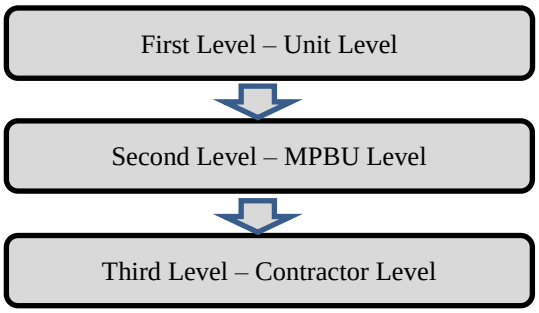


Figure 1: Level of Repair Process at RMAF

Each process need to be followed and approve by the specific meeting to seek an approval before can be proceed with the repair. The duration times needed for each activity are as in Table 1.

Table 1: The Average Time Taken for Components Repair Processes.

No.	Activities	Duration of time
(i)	Waiting for the defect report approval - KBK - KCK - MPBU	 1 Day 3 Days 3 Days
(ii)	Delivering components to MATRA I	30 Days
(iii)	Waiting for JKTek-MPBU	14 Days
(iv)	Waiting for T.D.I process by Contractor	180 Days
(v)	Waiting for JTP-MPBU	14 Days
(vi)	Waiting for JRH-MPBU s	14 Days
(vii)	Waiting for components repair	100-365 Days
(viii)	Waiting for Indent-MPBU	3 Days
(xiv)	Delivering component to RMAF	1 Day

2.0 METHODOLOGY

For aviation industry, spare inventories management system exists come together with maintenance planning. Lacking of spare parts in the inventory leads to low operational readiness and high holding cost [4]. In order to implement this research, the indent data for components that sent for repaired were taken starting from year 2012 to 2014. The data is analyzed by using the Pareto Chart. The purpose of this analysis is to determine the relationship between the duration of RTAT and the conventional spares management system practiced by RMAF. The analysis demonstrate RMAF conventional spares management system weaknesses that potentially can be improve and indirectly increasing the Ao percentage of Hercules C-130H aircraft.

2.1 Data Collection

RMAF uses SPKB for aircraft maintenance and spare parts monitoring system. All the details of the aircraft and components data that installed in the aircraft will be recorded in the SPKB. The data that used in this research is extracted from SPKB software starting from the year 2012 to 2014. The main focus of this research is based on the 10 critical components of Hercules C130H aircraft that frequently found defective and requires a long period of time to be repaired thus reducing the Ao percentage.

2.2 Pareto Analysis

Pareto analysis is a relatively simple methodology that is used when trying to determine which tasks or factors in an organization will have the most impact [5]. Pareto analysis is used to collect or sort all the data that being observed in order to prioritize the problem solving process. In this research, Pareto analysis was applied which involve analysis on critical components and value of indent.

2.2.1 Pareto Analysis – Critical Components

(i) All the defective data for each component extracted from SPKB.
(ii) The data is arranged by following with the year and amount of the defects.
(iii) 10 critical components that rank in the highest place were chosen to be implemented in the analysis.
(iv) Pareto graph is plotted by using Microsoft Excel.

2.2.2 Pareto Analysis – Indent Value

(i) The data of indent value based on 10 critical components collected were divided by range value starts from 0-25K, 25K – 50K, 50K – 100K, 100K – 150K, 150K – 200K, 200K – 250K and 250K above.
(ii) All the indent quantity data is calculated accumulatively (in percentage) from the total issued indent of the respective year.
(iii) All the indent value data is calculated accumulatively (in percentage) from the total issued indent of the respective year.
(iv) Graph of indent quantity versus indent value is plotted by using Microsoft Excel.

2.2.3 Analyze JKTek and JTP Meeting

JKTek and JTP Meeting are two important processes that need to be conducted in order to obtain approval to send components for repair. It is also as a platform to make decision

which company will be chosen for components repair. This process has a fix members and held twice a month in order to balance the amount of components that sent to repair. The delay of conducting JKTek and JTP Meeting will cause the late delivery of RTAT components.

2.2.4 Analyze RTAT

The delayed of the RTAT are viewed from two angles, that is delay from the RMAF (approval process) or the contractor (T.D.I or repair process). For RMAF, the delay time is taken from the moment components found defective until getting approval from JKTek to be sent for repair. Meanwhile, the delay from the contractors was due to the T.D.I implementation and the time duration needed to repair the component itself. The data obtained from the year 2012 to 2014 demonstrate a clear pattern on RTAT delay trend either from the RMAF or contractors.

2.2.5 Analyze T.D.I

T.D.I period of time is also one of the factors that can contribute to the delay on RTAT. The delay also can be caused from waiting for the JTP approval process and also from delay of T.D.I implementation by the contractor itself. The data obtained from the year 2012 to 2014 demonstrate a clear pattern or T.D.I trend delay either by RMAF or contractors.

2.2.6 Review the Current Process

The concept of conventional spare management system practiced by RMAF involves rigid processes and requires a long period of time. This research study in detail the duration of time taken for each processes that perceived existence of weaknesses and has the potential for improvements.

3.0 RESULTS AND DISCUSSION

3.1 Result of Analysis on 10 Critical Components

The data extracted from SPKB for the year 2011 to 2015 shows that 4171 defect report were reported and it includes 304 types of components. The graph as shown in Figure 2 shows 10 critical components that frequently found defective. Oil Pressure Transmitter (P/No: 61349-ST-104A), Engine (P/No: 35NIV27) and I/C Control Panel AIC18 (P/No: A81-91) are identified for being the most frequent defective components. It shows that the components were found defective for more than 100 times from the year 2011 to 2015.

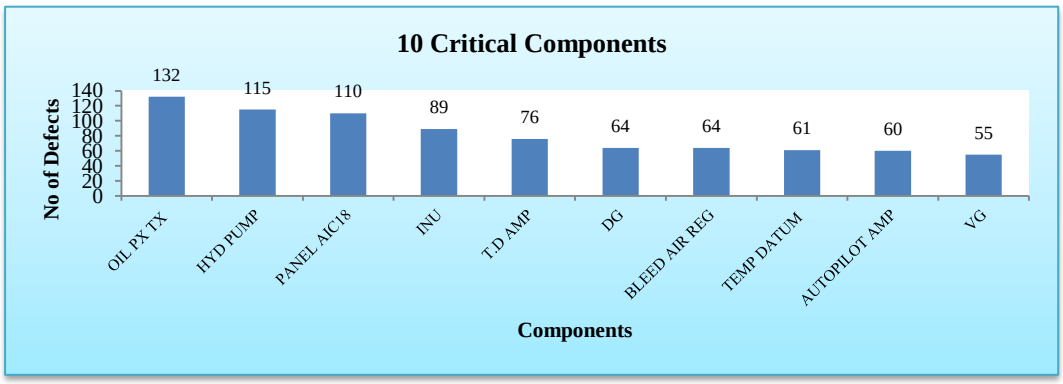


Figure 2: Graph of Hercules C-130H Critical Components

The repetitive occurrences of defective components is directly reducing the Ao percentage of Hercules C-130H aircraft. This situation became more critical if RMAF does not have any components for replacements and need to wait for the repaired components. Identifying the critical components that frequently found defective is very important in order to find the most suitable of new method or new spare management system to reduce RTAT.

3.2 Result of Pareto Analysis on Open Indent Quantity and Indent Value

3.2.1 Open Indent Quantity Versus Indent Value in Year 2013

This research is using open indent data for the year 2013 and 2014 issued by MPBU. MPBU had spent RM 586,534,000.00 for the quantity of 4809 open indent to repair the components on 2013. Based on the Pareto analysis, 24% of the expenditure for the year 2013 consumes 94% indent quantity issued by MPBU. 94% of the indent quantity was including the cost to repair the components at below RM 250K. Only 6% of the indent quantity was used to repair the components that are above RM 250K. Despites of that, the total cost spent were actually more than the cost that allocated for the open indent quantity. 4809 indents were still open where this indicates that the components are still at the contractor's premises, whether in the process of repairing or waiting for the JKTek or JTP approval.

3.2.2 Open Indent Quantity Versus Indent Value in Year 2014

For open indent of year 2014, MPBU had spent RM 410 million for 3836 open indent to repair the components. Based on the Pareto analysis, 25% of the expenditure for the year 2014 consumes for 94% of indent quantity issued by MPBU. 94% of the indent quantity was the cost to repair the components at below RM 250K. Only 6% of the indent quantity was used to repair the components that are above RM 250K. Despites of that, the total cost spent were actually more than the allocated of the open indent quantity. 3836 indents were still open where this indicates that the components are still at the contractor's premises, whether in the process of repairing or waiting for the JKTek or JTP approval.

3.3 Result of Analysis on JKTEK and JTP Frequency

MPBU is targeting to conduct 24 times JKTek Meeting and 12 times JTP Meeting in a year. From the analysis result, the total number of JKTeK and JTP Meeting was not achieving the KPI. It is clearly shown that the number of JKTek and JTP Meeting is dropping starting from the year 2013 to 2015. The dropping rate is 20% to 30% from the targeted value. Failing to conduct the JKTek Meeting caused components waiting to be repaired. Indirectly, this will be the contribution factor of the delayed on RTAT.

3.3 Result of Analysis on RTAT and T.D.I

The RTAT and T.D.I data is taken from the year 2012 to 2014. This analysis is based on the quantity of components that were returned to RMAF after repaired by the assigned contractor. For RTAT, the analysis shows that the components that had been returned after repaired were less than 40% for each year. This means that 60% components are still at the contractor premises – whether they are still being repair or waiting for the JKTeK/JTP approval. Meanwhile for T.D.I, the analysis shows that 33% of the components are waiting for JTP's approval for each year after the contractor did the T.D.I process. Indirectly, this will be another contribution factor of the delayed on RTAT.

3.4 Discussion

The main causes that contributed to the delay in the RTAT for 10 critical components Hercules C-130H aircraft was the weaknesses of conventional spares management system practiced RMAF. Failure in achieving the JKTek and JTP Meeting KPI has resulted long RTAT due to waiting JTP approval after T.D.I process. As a result, the analysis summary is as shown at Table 2.

Table 2: Analysis Summary

Analysis	Result
10 Critical Components	10 critical components are identified.
Open Indent Quantity and Indent Value	94% of open indent quantity consume for value indent below RM 250K.
JKTek and JTP Frequency	- JKTek; Not achieved KPI target up to 30%. - JTP; Not achieved KPI target up to 33%.
RTAT	- Only 33% components delivered to RMAF after completed the repair processes. - 67% components remain at contractor premises due to repair processes and waiting for JTP Approval.
T.D.I	33.33% of open indent quantity is waiting for JTP Approval every year.

4.0 CONCLUSION

As a result, it can be identified the weaknesses can be divided into two level. The first level is before the components were delivered to the contractors and the second level is the process after the components were sent to the contractors.

4.1 First Level Weaknesses

The first level of weaknesses involved with the time taken to get an approval from JKTek Meeting before the components can be send to contractors for T.D.I process. It took 51 days to get an approval from the initial process until sponsor to JKTek Meeting.

4.2 Second Level Weaknesses

The second Level of weaknesses involved components that already at the contractor premises but still waiting for JTP approval to proceed with the repairing process. The overall analysis has shown that the delays of components RTAT came from RMAF spare management process which specifically involves with the waiting for JTP approval.

REFERENCES

[1] Royal Malaysian Air Force (2007). *PU 2201 Organization Orders and Engineering Administrations*. Kuala Lumpur: Engineering Management Division, Air Force Headquarters.
[2] Royal Malaysian Air Force (2008). *PU 2302 Engineering Organization Procedure Manual*. Kuala Lumpur: Engineering Management Division, Air Force Headquarters.
[3] David Wheatley (2014). *Inventory-Location Problems for Spare Parts with Time-Based Service Constraints*. Doctor of Philosophy, University of Waterloo, Canada.
[4] Gu, J., et al. (2015). Efficient Aircraft Spare Parts Inventory Management under Demand Uncertainty. *Journal of Air Transport Management.* 42, 101-109.
[5] Kramp, K. H., et al. (2016). The Pareto Analysis for Establishing Content Criteria in Surgical Training. *Journal of Surgical Education*. 73, 892 - 899.

Communication Management during Design Phase in Construction Project

Shanti Devi Krishnaya[a], Khairur Rijal Jamaludin[b] and Syuhaida Ismail[c]

UTM Razak School of Engineering and Advanced Technology, Universiti Teknologi Malaysia, Jalan Sultan Yahya Petra, 54100, Kuala Lumpur, Malaysia
[a]shantinaidu_88@yahoo.com,[b]khairur.kl@utm.my, [c]syuhaida.kl@utm.my

Abstract – *All construction project execution requires communication between professionals in all the various stages of construction. These professionals transfer appropriate and relevant information to develop a buildable design that meets the client's requirements. As the project unfolds and the design is realized, information in the form of drawings, specifications and construction methods must be communicated from one expert to another. Therefore, using an appropriate communication method and communication medium to resolve construction and design problems is essential. The research sampled 55 professionals working in the construction industry Klang Valley. The study established that within the construction industry, there is a strong appreciation of the importance of project communication and its effects within the industry. During design stage, there are numbers of activity that need proper communication management for a better and smoother project delivery. In spite of that, there have been many hindrances to effective communication on construction projects during design phase. These include; unclear communication objectives, unclear channels of communication, ineffective reporting system, ineffective communication between the parties on the project, stereotyping and so on. Finally, the research proposed suggestions to improve the existing communication management to the higher level management.*

Keywords: Effective Communication, Construction Project, Communication Channel, Communication Barriers, Design Phase

1.0 INTRODUCTION

In construction industry, project communication is the soul of project management. By taking a closer look at the three main phases of construction projects - initiation, execution and closedown we can try to determine the role and impact of communication during each phase. Statistics shows that 74% of construction projects are unsuccessful [1-2]. One of the many factors that contribute to the failure of these projects is poor communication management among the project professionals. In the world of project management today, it has become increasingly more important to turn the efforts toward more effective means of communication. The ultimate goal of this research is to identify possible barriers of communication management and suggestions to the higher level management to improve it. Literature on communication in construction was studied. From the literature reviews possible barriers of effective communication is identified and possible suggestions to overcome this problems also identified. These questions survey were distributed

among the project professionals who has been doing two major mixed development projects together in Klang Valley. The research findings, including a more focused problem definition, the main research goal and a possible research are set-up to tackle the problem.

2.0 LITERATURE REVIEW

A typical construction project stages will start from design, construction and then completion of a project. A project manager is the person who runs the project from starting until completion of a project on behalf of the owner. Design stage is the brain of every project. Anything fails to plan here will result in disaster end of the project. It will give client high impact on cost and time matters. Communication improvements in early phases of projects would positively influence the quality as perceived by all stakeholders involved. Therefore a project manager provides and explains the necessary information for the team and other associated professionals with the project, he/she responsible to coordinate and collaborate [3-4]. Thus communication management during design stage is very crucial.

2.1 Three Channels of Communication

Vertical communication is the *upward* and *downward* communication flow that happens between different hierarchical levels of the organization. An example of *upward communication* is when a project team member provides the project manager with a status update of his assigned tasks. An example of *downward communication* is when the project manager shares the project goals with the project team [5].

Horizontal/Lateral communication refers to communication between people at the same organizational level. An example of horizontal communication is when project team members discuss project topics with each other [5].

Diagonal communication is the cross-functional communication between employees at different levels of the organizational hierarchy is described as diagonal communication. Diagonal communication is increasingly common in larger organizations with matrix or project-based structures [5].

2.2 Barriers of Effective Communication Management in Construction

Projects often 'fail' because simply fail to clearly articulate the vision and the project's success criteria. This vision must be successfully communicated to each stakeholder and team member. There are a lot of literature reviews on the barriers of effective communication management in construction project. The possible barriers identified and incorporated in survey questionnaires [6-8].

3.0 RESEARCH APPROACH

3.1 Research Approach

In order to fully appreciate the problem of communication in the construction project, the following questions have been articulated for study:

1. How much value do constructional project professionals place on communication?
2. How have project professionals managed communication on construction projects in present scenario?
3. What are the various communication channels used in construction project?
4. What are the important activities during design phase that communication is very essential?
5. What are the communication barriers on effective communication management?
6. What are the suggestions to improve the barriers identified?

3.2 Survey

This survey was done among the professional around Klang Valley who involves in construction project. Fifty five questionnaires distributed and forty six has responded. The professionals chosen for questionnaire are clients or owner of the project, architect, consultant from electrical, mechanical, structure and civil and also quantity surveyor background. The survey questions sent to respondents using an online portal name Survey Monkey. Once the questionnaire developed, the link sent out to the participants. The survey has four sections, Section A is demographic data and Section B, C and D is in depth survey on communication management.

4.0 RESULTS AND DISCUSSION

The data collected from survey and processed using MINITAB software. The mean and standard deviation were tabulated. Only the mean value of four and above is considered as the most significant findings and further discussed.

4.1 Section A - Demographic Data

In this section, the background study of the participants surveyed. The particulars surveyed are the gender, age, nature of your profession, level of education, years of experience, current level of position in the organization, and numbers of projects undertaken by the professionals. Based on the result, most of the respondents are project managers and senior project manager who have undertaken more than five projects. This information is very important because the next part of the survey will be in depth survey all about communication managements in project based on their passed experience.

4.2 Section B - Activities during Design Phase Where Communication Management Is Very Important

Below is the survey result arranged from highest impotency (mean = 4.48) to the lowest impotency (mean = 3.96)

1. Final contract documents preparation by quantity surveyor once design drawings finalized and approved
2. Final design drawings preparation by architect and consultant for tender
3. Preliminary concept planning and brainstorm by all parties
4. Cost Estimation based on preliminary concept
5. Cost Plan presentation by Quantity Surveyor
6. Based on approved cost plan by client, revised concept presentation
7. Preliminary Concept presentation
8. Design coordination meetings / workshops by all parties
9. Preliminary Design drawings preparation and presentation
10. Design brief report presentations by consultants

4.3 Section C - Barriers of Effective Communication Management by Professionals during Design Phase Based On the Professional Working Experience

Below is the survey result of barriers of effective communication management which has scored the highest (mean = 4.28) to the lowest (mean = 4.09). Only mean four (4) and above is considered for discussion.

1. Ineffective communication between the parties on the project which results in time delay/waste
2. Ineffective reporting/recording system in an organization - lack of standard operation procedure in communication management in an organization
3. Unclear communication objectives whenever any meetings arranged which always never meet the goal of meetings
4. Too many levels and parties or standard operating procedure set by an organization to get approval for everything even for less crucial items
5. Poor listeners who always wrongly misinterpreted the information wrongly
6. Assign less experience person during design stage who could not capture crucial information from other parties
7. Lack of concern/responsibility by the individual who involve in communication which results in poor information absorption

Out of 15 barriers identified from the literature review, only seven scored mean more than four which project professionals find important barriers of effective communication during design phase based on their project experience.

4.4 Suggestions to the Higher Level Management for Better Communication Management during Design Phase

Below is the survey result of suggestions to improve current communication practices to the higher level management which has scored the highest (mean = 4.41) to the lowest (mean = 4.07). Only mean four (4) and above is considered for discussion.

1. Project managers to brief their project team regularly during all the activities in design phase to achieve the objectives and avoid any misleading of information.
2. Create a work breakdown structure in every organization once the project team formed
3. Every member of the project team to be briefed in very early stage by the project manager on the verbal, written and contractual communication set by Standard Operating Procedure of the company for a better and smoother project delivery
4. Project managers to improve their leadership skills so the communication management will be more effective during design stage
5. Clearly assign the individual's role in a project team for proper communication management (Project organization chart)
6. Always assign or co-assign well trained / well experienced person during design phase to avoid any miscommunication and to lead the juniors
7. Improve the current Information and Communication Technology (ICT) in organization for better and faster communication between other organization
8. The ultimate decision makers (owner, director, CEO, COO) for crucial issues from all the organization (client, architect, consultant and quantity surveyor) to be easily communicated by Project managers time to time to avoid any time delay.
9. The ultimate decision makers (owner, director, CEO, COO) for crucial issues from all the organization (client, architect, consultant and quantity surveyor) to be easily communicated by Project managers time to time to avoid any time delay.
10. All the project team members to be kept in the project loop in the every channel of communication (from junior project executive to senior project manager) for a better knowledge transfer during design stage until finishing of the project.
11. Every organization to review the existing Standard Operating Procedure in verbal, written and contractual communication management to make it less complicated , avoid any redundant work by any parties and more effective

These suggestions are derived from the barriers and also from the literature review.

4.0 CONCLUSION

Since there has been no empirical work that quantifies explicitly the extent to which communication determines the success of construction projects and to address the increasing global nature of construction projects, an attempt to study barriers of

communication and suggestions to improve communication in construction projects through "Literature Study" and "Interview Survey" is made. Analysis of data helped in developing the questionnaires based on relationships amongst the identified key problem statement with the focus on the project stakeholders. The questionnaire has been designed for quantitative analysis by statistical analysis tools and contains structured questions. To this end, a pilot study has been conducted to test the effectiveness of the questionnaires and questionnaires were finalized. Through questionnaire survey among project stakeholders it is identified the possible barriers of effective communication in current practice and suggestions to improve the barriers also identified. Almost all the barriers and suggestions has received a mean value four and above. This shows that majority project professionals are going through the hindrances for effective communication management in their project. Thus, these suggestions will be proposed the project professionals and their higher level management of respective organization to improve the current and future project practices and performance.

REFERENCES

[1] Ballan and El-Diraby, "A value map for communication systems in construction," Journal of Information Technology in Construction, November 2011, Vol. 16, pg. 745-760.

[2] Benita Zulch, “Leadership communication in project management,” Journal of Social and Behavioral Sciences, 27th IPMA World Congress Procedia - Social and Behavioral Sciences 119(2014), pp. 172 – 181.

[3] E.O. Aiyewalehinmi, “Factor Analysis of Communication in the Construction Industry," The International Journal of Engineering and Science (IJES), vol 2, Issue 10, pp. 49-57, 2013.

[4] Fenn, P., Lowe, D., & Speck, C. (1997). Confict and dispute in construction. Construction Management and Economics, 15, 513- 518

[5] Gray, C., Hughes, W. and Bennet, J. (1994), The Successful Management of Design, The University of Reading Centre for Strategic Studies.

[6] Keyton J (2011). Communication and organizational culture: A key to understanding work experiences. Thousand Oaks, CA: Sage.

[7] Kumaraswarmy, M.M. and Yogeswaran, K. (1997), Encouraging conflicts, discouraging disputes and managing claims. Nicmar journal of construction management, xii, 15-30.

[8] Wikforss, O. and Löfgren, A. “Rethinking communication in construction”, ITcon 12, 337-346, http://www.itcon.org/2007/23, 2007.

Continuous Improvement for Rework Elimination in Chemical Process Industry

Mow Jiun Wei[a] and Khairur Rijal Jamaludin[b]

UTM Razak School of Engineering and Advanced Technology, Universiti Teknologi Malaysia, Jalan Sultan Yahya Petra,54100, Kuala Lumpur, Malaysia
[a]jiunwei_1401@hotmail.com, [b]khairur.kl@utm.my

Abstract – *This paper examines the effectiveness of continuous improvement and lean manufacturing in rework elimination of chemical process plant. High rework was observed in P6, distillation plant. High rework indicates high wastage in the process plant. The project is being carried out in three stages – root causes identification, lean implementation and verification on lean effectiveness. In the first stage of study, vacuum interruption and pump breakdown were identified as the causes of high rework. This was done through review on the P6 rework records and semi-structured interview with plant supervisors. Five-Why method was selected as lean tools in the root causes analysis upon reviewing on existing SOP. There are two proposed improvement projects, which are auto blow down system for boiler feed water using timer control and nitrogen blanketing system in thermal oil expansion tank using interlock control. In the third stage of study, rework records were reviewed and supervisors were interviewed to verify the effectiveness of lean implementation. There is a reduction of 57-68% in quantity of product rework, improved employee satisfaction, improved vacuum stability and thermal oil quality after lean implementation.*

Keywords: Continuous improvement, Lean Manufacturing, Rework Elimination, Chemical Process

1.0 INTRODUCTION

Continuous improvement (CI), also named as "Kaizen" is systematic way to measure, analysis and improve processes in organizations to identify areas that can produce breakthrough results in manufacturing efficiency, product quality and the operating costs. According to [1], CI is defined as small incremental changes in production or work practices that will bring improvement in performance through wastes elimination within the organization.

In the constantly changing economic environment, manufacturing industries are facing more intense global competition than before. Variable raw material costs, increasing operational costs, improved quality requirement and increased regulations on the waste reduction as well as utilities conservation are major challenges of the chemicals manufacturers [2].

Manufacturing industries are in need to seek new manufacturing system such as lean manufacturing and continuous improvement (CI) to ensure they are competitive and flexible to respond to new demands [3]. Lean manufacturing is one of the initiatives that has been widely adopted by many different industries globally to optimize the

production process through waste elimination [4-5]. Through eliminating unnecessary processes, lean increases productivity, enhances quality and shorten lead times and hence reduces overall operating costs [6].

The application of lean tools depends on the implementation context. In process industries, lean practices that are commonly used to improve performance are more related to waste elimination [7].

In order to eliminate wastage or rework, it is critical to recognise the root cause of the problem and attempt to solve the problem in a systematic way. Common analysis tools for root cause problem solving (RCPS) including current reality tree, cause-and-effect (CED), interrelationship diagram (ID) [8-11] and the Five-Whys Analysis [12-14].

Taiichi Ohno was an avid proponent the Five-Whys Analysis root cause problem solving [15]. It was a result of observation of Taiichi Ohno during his working experiences in Toyota. He concluded that mistakes are unavoidable and the best way to get out of it is through root cause identification and solving it [16].

Lean manufacturing has been applied extensively in discrete industries such as automotive to generate optimum value from the process to achieve continuous improvement (CI). However, implementation of lean production in process industries is not well-established and uncommon [17]. Some adjustments on the lean implementation approach is needed before adopted by the chemical process industries, where production is carried out in large batches and the industry is not considered as make to order business [18]. In this regard this study will contribute to demonstrate "how" and "what" solutions can be implemented to resolve high rework issues through the use of lean tools.

In a chemical processing plant, products are being processed in large quantities. Finished product produced from the manufacturing plants has to follow the specifications as per customer requirement, such as product purity, color, thermal heat stability and odour. The products generated from the production plants might not be able to fulfill the specifications required at all time. Off specifications products are normally rework to produce right specification product to meet the customer requirements.

In this research project, high rework was found in the fatty acid distillation plant, Plant 6. High rework implies that higher processing cost incurred, generation of unnecessary waste, more frequent handling of non-routine works, and lower down the overall plant throughput. These are all non-value added activities that should be eliminated [19-20].

The objectives of this study are to:
(1) identify the root causes of high rework in Plant 6;
(2) select the appropriate lean tools and execute the proposed improvement projects;
(3) verify on the effectiveness after project implementation.

2.0 METHODOLOGY

2.1 Overview of Distillation Plant

In a chemical distillation plant, the column top vacuum and bottom temperature stability are the most critical control parameters to ensure the separation processes are effective. Vaporisation in the column as a result of heat transfer will generate large amount of fatty acid vapours. Condensation at the upper part of column is achieved through heat exchange between fatty acid vapours and de-mineralized water, called boiler feed water. Effective condensation of fatty acids vapours in distillation column is crucial to assure stable vacuum is maintained.

In Plant 6, the required temperature is achieved through heating the bottom shell of the column, by using heat transfer oil, called thermal oil. Since the thermal oil system is a closed loop system, any thermal expansion in the system will be catered in an expansion tank. A good quality of thermal oil, which is free from moisture and solids content is needed to ensure smooth operation of the transferring pumps, since the mechanical seal of pumps might be broken by these solids particles.

There are 3 methodologies involved in this research, which are document review, semi-structured interview and execution of proposed improvement projects.

2.2 Document Review

A thorough review on the Plant 6 rework records is carried out in identifying the root causes of rework. Subsequently, the review of existing standard operating procedure (SOP) is done before appropriate lean tools can be selected. Upon implementation of proposed improvement, the rework record of Plant 6 is being reviewed to verify on the effectiveness of lean implementation. This will be supported by 2 other documents, which are the trending of vacuum reading in Plant 6 distillation column and quality of heat transfer oil.

2.3 Semi-structured Interview

An interview with Plant 6 supervisors is done to further understand on the root causes of rework and how the existing procedure can be further improved. After the proposed improvement is executed, same approach will be carried out to verify the effectiveness in terms of the employee satisfaction.

2.4 Execution of Proposed Improvement

Upon identification of root causes and selection of lean tools, the proposed improvement will be executed in Plant 6 to resolve the root causes highlighted. A brief write up of the proposed improvement will be done and presented to the management of the company. Economic analysis on the proposed improvement will also be done. Payback period and break-even point for each project will be made known to the management prior implementation.

3.0 RESULTS AND DISCUSSION

The rework records in Plant 6 since January to June 2016 is being reviewed and the causes of reworks are being categorized as per Figure 1 below.

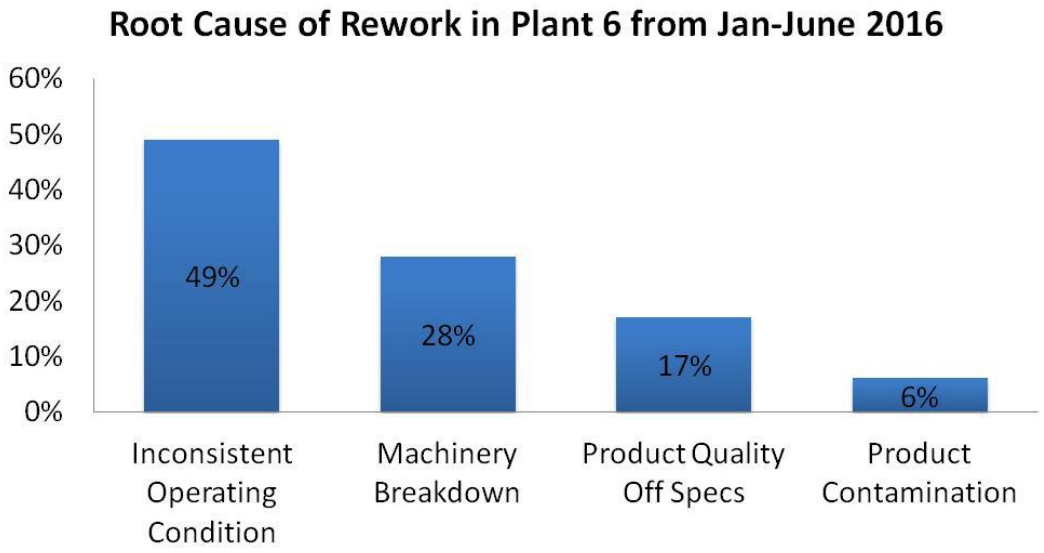


Figure 1: Reasons of Rework in Plant 6 from January – June 2016

Inconsistent operating condition and machinery breakdown are the two major causes of rework in Plant 6. Upon review on the existing SOP, Five-Why method is being selected as the lean tool to identify the root cause of each issue as per Figure 2 and Figure 3 below.

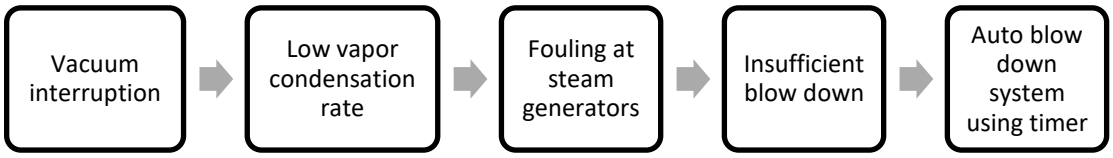


Figure 2: Five Why Analysis of Vacuum Interruption

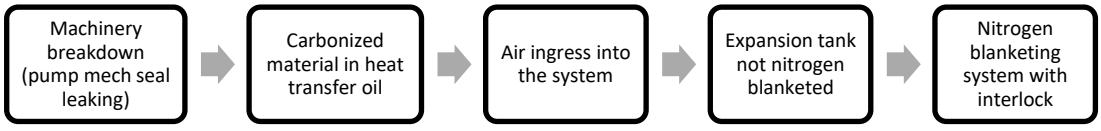


Figure 3: Five Why Analysis of Machinery Breakdown

Based on the results of Five-Why analysis, there are 2 improvement projects proposed. In order to tackle the vacuum interruption issues, an auto blow down system with timer control for the boiler feed water is proposed. A nitrogen blanketing

system with interlock control is proposed to resolve the pump breakdown issues. These projects are called project 'A' and 'B'.

The economics of the two proposed improvements are being analysed before execution, as per Table 1 below.

Table 1: Economic Analysis of Proposed Improvement Projects

	Auto Blow Down System Using Timer (Project A)	Nitrogen Blanketing System with Interlock (Project B)
Payback Period	3 months	5 months
Break Even Point	3rd month	4th month

The economic analysis for both projects indicates that the proposed project is favorable to be implemented. Payback period and breakeven point for both projects are within the acceptable period for the company, which is below 18 months. The projects proposed were implemented in October after the hardware installation took place in the plant stoppage in September 2016.

The schematic diagram for the proposal is as per Figure 4 and Figure 5 below.

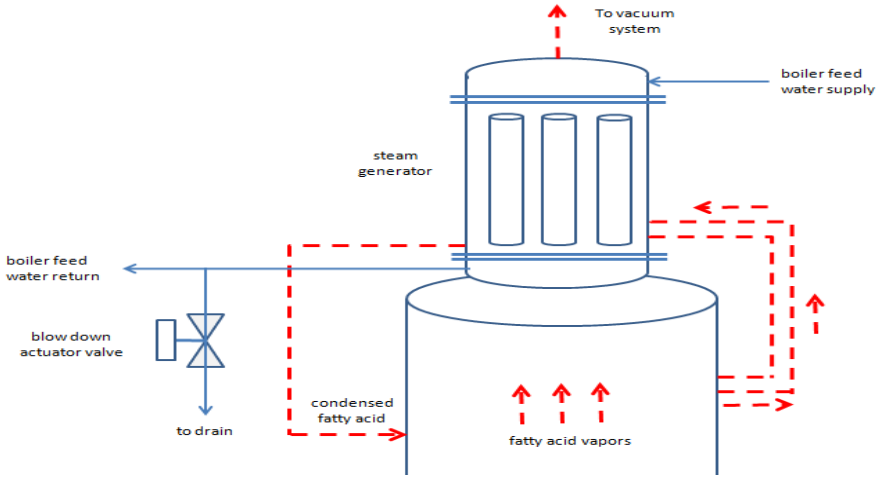


Figure 4: Schematic Diagram for Auto Blow Down System Using Timer

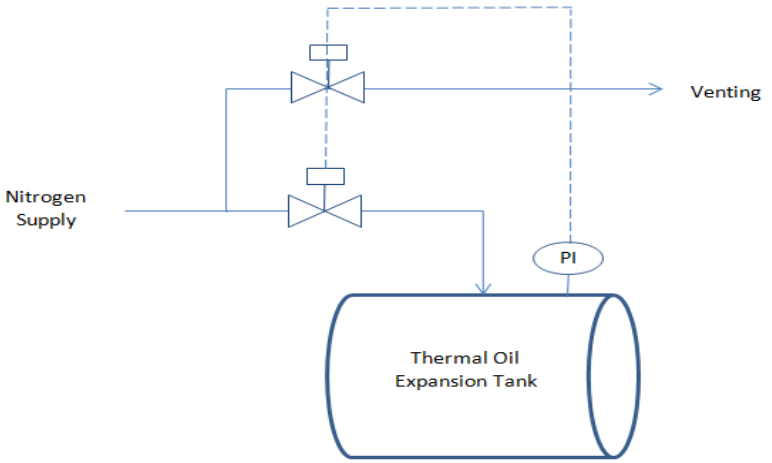


Figure 5: Schematic Diagram for Nitrogen Blanketing System with Interlock

Rework data for Plant 6 due to vacuum interruption and pump breakdown is then being reviewed again after the implementation. There is 68% and 57% reduction for vacuum interruption and pump breakdown in the rework observed in the month of October and November.

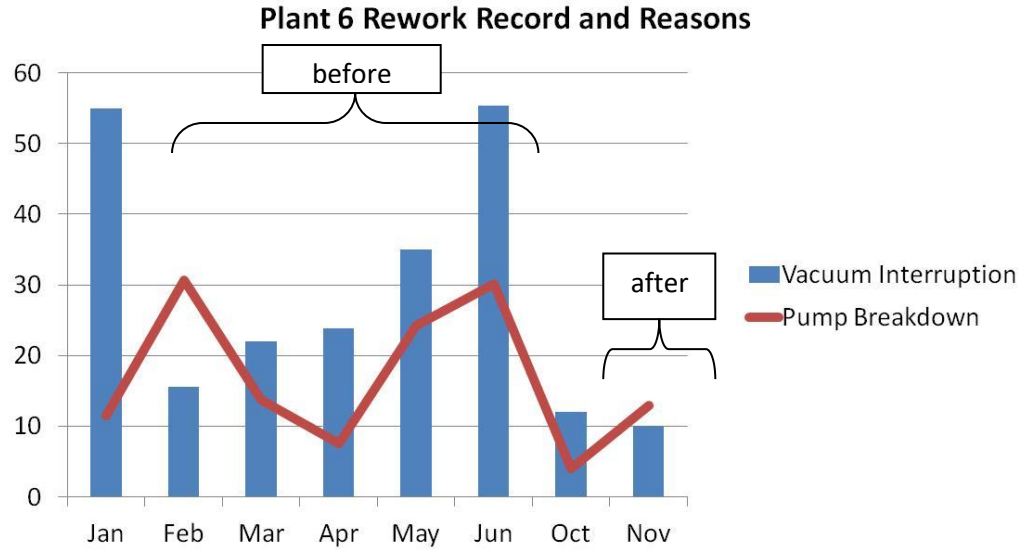


Figure 6: Plant 6 Rework Record Before and After Lean Implementation

Vacuum trending in distillation column is being reviewed to verify the effectiveness of project 'A' in improving vacuum performance. There is a significant improvement in terms of the vacuum stability as per shown in Figure 7 below.

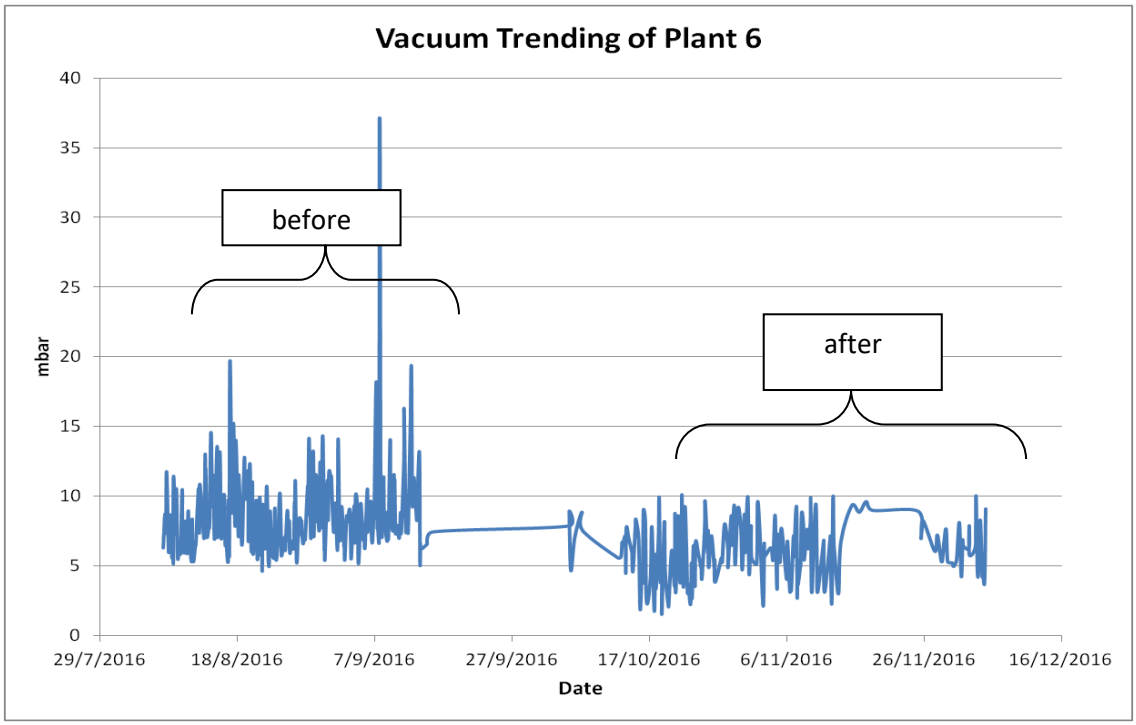


Figure 7: Comparison of Plant 6 Vacuum Trending Before and After Lean Implementation

For project 'B', the quality of heat transfer oil is being compared as per Table 2 below to verify on the effectiveness of nitrogen blanketing. Both solids and moisture content have reduced after the nitrogen blanketing project was implemented.

Table 2: Quality of Heat Transfer Oil

Parameter	Control Limit	Before (June'2016)	After (Nov'2016)
Acetone insoluble solids (mg/100mL)	<400	551	412
Moisture (ppm)	<700	806	612

4.0 CONCLUSION

This paper presents a case study of the rework elimination in chemical process industry through continuous improvement. In the first stage of research, vacuum interruption and pump breakdown were identified to be the two main causes of high rework in Plant 6. Subsequently, the root causes identification and lean proposal were being done through application of Five-Whys Method. It provides a structured approach to root causes identification and proposed correction that focuses on reducing and eliminating rework in chemical manufacturing plant. Two lean projects were then proposed and implemented based on Five-Why analysis on top of thorough understanding on the process flow. A total of 57-68% reductions in rework were seen after implementation of the lean projects that were proposed. Apart from that, improved vacuum stability and thermal oil quality, as well as increased employees' job satisfaction were also observed after lean projects were implemented. All the research objectives of this project paper were achieved, i.e identification of root causes through Five-Whys Method and implementation of lean proposal which has eventually brought improvement in terms of eliminating product rework. However, long term solution can be further proposed and implemented to eliminate rework in future. This approach can be extended to other manufacturing areas to improve the equipment efficiency, breakdown, as well as customer complaints [19]. This study also managed to fill the apparent gap between theory and practice of lean management through solving a practical problem in the manufacturing plant, as a response to the study by [21].

REFERENCES

[1] Marin-Garcia, Juan A, Manuela Pardo del Val, and Tomás Bonavía Martín. "Longitudinal Study of the Results of Continuous Improvement in an Industrial Company." Team Performance Management: An International Journal 14, no. 1/2 (2008): 56-69.

[2] Higgins, Kevin T. "State of Food Manufacturing: The Quest for Continuous Improvement." Food Eng 78, no. 9 (2006): 61-68.

[3] Black, JT. "The Design of the Factory with a Future, 1991." New York, NY: McGraw-Hill, 1991.

[4] Schonberger, Richard J. "Japanese Production Management: An Evolution—with Mixed Success." Journal of Operations Management 25, no. 2 (2007): 403-19.
[5] Ghosh, Manimay. "Lean Manufacturing Performance in Indian Manufacturing Plants." Journal of Manufacturing Technology Management 24, no. 1 (2012): 113-22.
[6] Shah, Rachna, and Peter T Ward. "Lean Manufacturing: Context, Practice Bundles, and Performance." Journal of operations management 21, no. 2 (2003): 129-49.
[7] Lyons, Andrew Charles, Keith Vidamour, Rakesh Jain, and Michael Sutherland. "Developing an Understanding of Lean Thinking in Process Industries." Production Planning & Control 24, no. 6 (2013): 475-94.
[8] Ishikawa, K. Guide to Quality Control. Vol. 2nd rev. Ed., Tokyo: Asian Productivity Organization, 1982.
[9] Mizuno, S. Management for Quality Improvement: The Seven New Qc Tools, . Cambridge, MA: Production Press, 1988.
[10] Goldratt, E.M. It's Not Luck. Great Barrington, MA: North River Press, 1994.
[11] Doggett, A Mark. "Root Cause Analysis: A Framework for Tool Selection." The Quality Management Journal 12, no. 4 (2005): 34.
[12] Pylipow, Peter E, and William E Royall. "Root Cause Analysis in a World-Class Manufacturing Operation." Quality 40, no. 10 (2001): 66.
[13] Nelsen, Dave. "To Find the Root Cause, That's Why." Quality Progress 36, no. 9 (2003): 104.
[14] Pinsky, D. "Failure Analysis of Electronics Assemblies." Electronic Packaging & Production Vol. 43, no. No.2 (2003).
[15] Alukal, George. "Lean Kaizen in the 21st Century." Quality progress 40, no. 8 (2007): 69.
[16] Ohno, Taiichi. Toyota Production System: Beyond Large-Scale Production. crc Press, 1988.
[17] Gebauer, Heiko, Michael Kickuth, and Thomas Friedli. "Lean Management Practices in the Pharmaceutical Industry." International Journal of Services and Operations Management 5, no. 4 (2009): 463-81.
[18] Pieter van Donk, Dirk. "Customer-Driven Manufacturing in the Food Processing Industry." British food journal 102, no. 10 (2000): 739-47.
[19] Murugaiah, Uthiyakumar, Samuel Jebaraj Benjamin, M Srikamaladevi Marathamuthu, and Saravanan Muthaiyah. "Scrap Loss Reduction Using the 5-Whys Analysis." International Journal of Quality & Reliability Management 27, no. 5 (2010): 527-40.
[20] Benjamin, Samuel Jebaraj, M Srikamaladevi Marathamuthu, and Uthiyakumar Murugaiah. "The Use of 5-Whys Technique to Eliminate Oee's Speed Loss in a Manufacturing Firm." Journal of Quality in Maintenance Engineering 21, no. 4 (2015): 419-35.
[21] Tracy, D.L. and Knight, J.E. "“Lean Operations Management: Identifying and Bridging the Gap between Theory and Practice”." The Journal of American Academy of Business, Vol. 12, no. No. 2 (2008): pp. 8-14.

Management Control Package in Japanese Overseas Subsidiaries in Malaysia and Indonesia

Junichi Murata[1,a], Abdul Rahman Abdul Rahim[2,b] and Norazmein Abdul Raman[2,c]

[1] School of Business Administration, Graduate School of Meiji University, 1-1 Kanda-Surugadai, Chiyoda Tokyo 101-8301, Japan
[2] Razak School of Engineering and Advanced Technology, Universiti Teknologi Malaysia, 54100 Jalan Semarak, Kuala Lumpur, Malaysia
[a]*murata@ken-suzuki.net*, [b]*rahmanar@utm.my*, [c]*norazmein.kl@utm.my*

Abstract – *This paper aims to investigate the design of management control package (MCP) framework of Japanese subsidiaries in Malaysia and Indonesia, and to investigate the operation on MCP of Japanese subsidiary in Malaysia. In order to achieve the two objectives, interview survey was carried out on twelve Malaysian and Indonesian subsidiaries of Japanese companies. This study focused on the Malaysian subsidiary of Japanese company A which uses MCP. The study site is a leading Japanese manufacturing company dealing with automobile parts. Six selected interviewees in the study were the chairman, managing director, manufacturing manager and Japanese manager, Malaysian manager (two people) in Malaysian subsidiary (Total: eleven people, sixteen times, and forty hours). Results indicate the following three things. One is the effectiveness of participative budgeting as package. Specifically, the effectiveness that has not been pointed out in previous studies on participatory MCP showed that the result control based on participatory budget had influence not only on cultural control but also on action control. Academic significance can be seen also in showing new findings. Secondly, this paper suggested the necessity of informal cultural control. Thirdly, the interview data show that budgeting, manuals and procedures, training/ education may be modified to operate effectively in foreign subsidiary by the effects of national culture. Only a few studies focused on MCP of Malaysian subsidiary of Japanese company as research sites. This study sheds light on this research area.*

Keywords: Management control package, Participative budgeting, Malaysian and Indonesian subsidiary

1.0 INTRODUCTION

Management control is the process of "ensuring that managers acquire and use resources efficiently and efficiently to achieve the objectives of the organization" [1]. MCS is a mechanism to repeat the above process. Since MCS was proposed in Anthony [1], accounting control has played its part.

Meanwhile, MCS defined by Anthony [1] is regarded as a traditional MCS, and studies on the extension of traditional MCS came to be seen. These studies based on the view that "control is not used alone, but various controls contribute to achieving organizational objectives as a whole" [1]. Discussions are being developed. The whole of this control is called a management control package (MCP) [2]. For example, Simons [3] achieved a strategy realized by mutually complementary work of

four control systems, a creed system, a business ethics boundary system, a diagnostic control system, and an interactive control system. In addition, Malmi and Brown [2] advocated an MCP consisting of five controls: planning control, cybernetic control, remuneration and salary control, administrative control, cultural control [2]. Merchant and Van der Stede [4] shows MCP including three controls of result control, action control, cultural control, and cultural control which has the function of supplementing the result control and action control.

While discussion on MCP as an extension of traditional MCS is underway, research has been made to point out the usefulness of MCP at overseas subsidiaries. For example, Ghoshal and Nohria [5] classified overseas subsidiaries of companies in Europe and the United States using two axes, the complexity of the local environment and the local management resources, and MCP is useful for integrated subsidiaries which he classified as one type of overseas subsidiaries. MCP consists of three controls: centralization, formalization, and normative integration. Martinez and Jarillo [6] classified overseas subsidiaries in Spain using the axes of two strategies of localization and integration, suggesting that MCP will be effective if the degree of integration is high. They use MCP framework consisting of two of formal control and informal control. Tseng et al. [7] classified the type of overseas subsidiaries of multinational corporations entering Taiwan into the two axes of knowledge transaction density in the internal group of multinational corporations and knowledge transaction with local companies. MCP includes four categories: bureaucratic management mechanism, personnel mechanism, performance evaluation mechanism, and cultural management mechanism. The usefulness of MCP was suggested in operation type subsidiaries and self-contained companies. Based on the above research results, there are also studies suggesting that MCP is useful even at overseas subsidiaries of Japanese companies.

Based on these previous studies, there are a few studies investigated Japanese subsidiaries in Southeast Asia. In recent years, the number of Japanese companies entering Southeast Asia is increasing. Meanwhile, it is also reported that these Japanese companies are suffering from the motivation of local employees. For example, Asada and Tomo [8] shows actual situation that local companies are suffering from cost overrun and deterioration of product quality based on the field survey to Japanese companies in Southeast Asia. Therefore, the first question (RQ1) arise here is what kind of MCP do Southeast Asian subsidiaries of Japanese companies have? Then for the RQ2, how do they operate MCP of Southeast Asian subsidiaries of Japanese companies?

2.0 THE USEFULNESS OF MCP

The usefulness of MCP was suggested in considering MCS of overseas subsidiary. In MCP research at overseas subsidiaries, not only accounting controls, but also non-accounting controls were used. For example, Ghoshal and Nohria [5] revealed that overseas subsidiaries used the three controls of centralization, formalization, and socialization in accordance with the complexity of the local environment and the degree of local management resources. In the case of In the case of Martinez and Jarillo [6], overseas subsidiaries combined two means of formal control and informal

control according to the degree of integration and localization. Tseng et al. [7] suggested that the MCP of overseas subsidiaries consist of four management mechanisms: bureaucratic, personnel, performance, cultural mechanism are used in combination depending on the density of knowledge transaction density within the company and the degree of knowledge transaction density with local enterprise.

The above discussion has been made in the previous research, and if it relies on these arguments, the usefulness of MCP is suggested as MCS of the overseas subsidiary. In order to maintain objective consistency and promote autonomous action of employees who have different cultures and customs, it is necessary not only to use accounting controls but also to encourage corporate actions by spreading the values and philosophies of the organization, and it is considered necessary to regulate corporate undesirable action by the code of conduct.

The MCP framework of Merchant and Van der Stede [4] consisting of three controls on results, action and culture is considered useful for understanding the MCP of overseas subsidiaries. Their framework allows us to classify the frameworks used in previous studies.

3.0 RESEARCH DESIGN

For the analysis of MCP, we use the framework of Merchant and Vander Stede [4]. Their framework consists of three parts: result control, cultural control, and action control. The result control is control by performance evaluation. It is a performance-based compensation system that gives high-performance employees high remuneration and low compensation for employees with low performance (p. 29). Action control is a control that monitors whether employees are taking desirable actions for companies (p. 81). Cultural control is a control that encourages the sharing of employee values (p. 90). Case study by interview survey is conducted. The interview survey uses semi structured interviews. A semi-structured interview is an interview method that decides in advance only the purpose of the interview survey.

The result of the interview is recorded on the IC recorder, and the result is documented later. I gathered information via e-mail from time to time. In addition, we tried to understand the contents by using secondary documents such as in-house documents acquired at the time of visit, securities reports, and published materials on the website of the parent company. This paper conducted an interview survey on twelve Malaysian and Indonesian subsidiaries of Japanese companies. In addition, this research focuses on the Malaysian subsidiary of Japanese company A which uses MCP. This research site is a leading Japanese manufacturing company dealing with automobile parts. This study has interviews with Chairman, Managing director, Manufacturing manager, Japanese manager (six people), Malaysian manager (two people) in Malaysian subsidiary (Total: eleven people, sixteen times, and forty hours).

4.0 RESULTS AND DISCUSSION

With regard to RQ1, this study found out that only company A has MCP. I keep having interview with company A to identify RQ2. Interview results were revealed in Table 1.

Table 1: Interview results to RQ1

Japanese Company	A	B	C	D	E	F	G	H	I	J	K	L
Subsidiary		Malaysia						Indonesia				
Type of industry	M	M	M	M	M	M	M	M	M	T	S	S
Result controls		Budgeting										
Action controls		Rules and procedures								-	-	Rules and procedures
Cultural controls	Expatriate manager, cross training and employee exchange meeting	-	-	-	-	-	-	-	-	-	-	-

Note: M is manufacturing, S is services, and T is trading.

Regarding to RQ2, this study investigated that the following three controls based on Merchant and Van der Stede (2007). Interview results to Malaysian subsidiary of Company A were revealed in Figure 2. Company A only has MCP. I keep having interview with company A to identify RQ2.

Malaysian subsidiary of company A uses participative budgeting as result controls.In the research on MCP for overseas subsidiaries, this is a new discovery as it seems there is no research which discussed participatory MCP. On the other hand, unless the research site is limited to overseas subsidiaries, research suggesting participatory MCP is starting to be seen. Knights and Willmott [9] clarified the existence of a participating MCP for insurance companies. Abernethy and Chua [10] and Inoue [11] carry out a case study for hospitals. Abernethy and Chua [10] considered the three controls of results, culture and governance as MCP framework, and Inoue [11] considered the two consequences and culture controls as MCP framework. They are considering the necessity of a participatory MCP to make doctors and nurses participate in result control. When comparing these previous studies and cases of company A, deepening the discussion, similarities and differences were observed in the following points. First, as a similarity point, there is a point that the result control assuming participatory budget has influence on cultural control. Next, the difference is that the result control assuming participatory budget has influence on action control. In case of Company A's Malaysian subsidiary, introduction of participatory budget was urging compliance with Malaysian employees' rules and procedures. Specifically, the Malaysian subsidiary was trying to encourage employees' motivation to achieve budget by having Malaysian employees participate in the process of budget management, but the improvement in motivation for budget achievement is expected to achieve budget Leading to suppression of prohibited action to inhibit.

The subsidiary of Company A, employee exchange meeting was used as a means of cultural control. Specifically, in previous research, as a means of cultural control, we only pointed out initiatives such as the chanting of the management philosophy and conferences and lectures to disseminate the top message. On the other hand, in the case in this paper, the management philosophy is being penetrated through informal communication among employees at the employee exchange meeting, and events that were not seen in previous research were observed, so this point It can be said that it is a feature point. Even in Merchant and Van der Stede [4], there is a limit to penetration of management philosophy and sharing of values only with formal cultural control and the necessity of informal cultural control is stated (P. 91), the case of this paper proved their argument. In addition, the employee exchange meeting of Company A's Malaysian subsidiary was involving others Japanese companies entering Malaysia.

Specifically, the company's external exchange meeting took place, promoting understanding of the values of the local employees by the information sharing and the local employees through the outside exchange meeting. In other words, in other words, it can be seen that efforts of cultural control by inter-company cooperation were done, and this point can also be regarded as a characteristic point not found in previous research. In order to realize budget and improvement of learning which the strategic objective of the subsidiary is, MCP has seen the following changes from the time of establishment to the present day. First, concerning result control, budget management was changed. The budget management became led by the subsidiary company, and the Malaysian managers were involved in that process, thereby increasing the number of business improvement cases. Next, with regard to cultural control, quality-oriented management philosophy penetrated by increasing the number of Japanese managers, adding internal and external training, employee exchange meeting. Finally, with regard to action control, prohibited actions were suppressed by preparing production procedure manuals in local languages, setting up procedural guard monitors. According to interviewers, these changes have considered the influence of national culture between Japan and Malaysia.

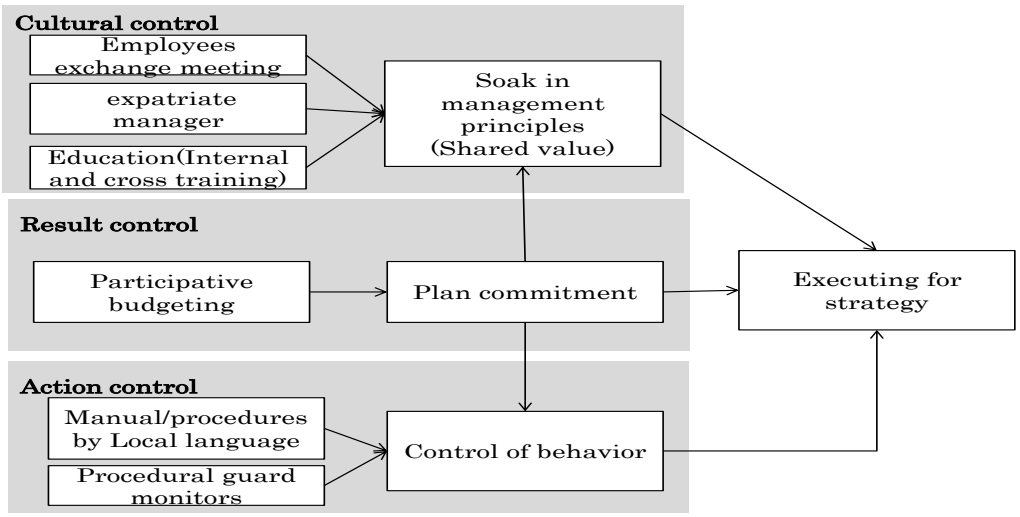


Figure 2: Interview results to RQ2

5.0 CONCLUSION

This paper presents four meanings. Of the four meanings, three are academic significance and one is practical significance. Firstly, this paper identified the use of participating MCP. Secondly, it suggested the necessity of informal cultural control. Thirdly, it suggested the probability of the effects of national culture to MCP. Finally, this is a case study of MCP for Japanese subsidiaries in emerging countries.this study conducts case studies of MCPs targeting two countries, Malaysia and Indonesia located in Southeast Asia. The outcome of this research is likely to help Japanese companies. The practical significance of this paper seems to be great.

REFERENCES

[1] Anthony, R. N. Planning and Control Systems: A Framework for Analysis. Harvard University, Division of Research: New York, 1965.
[2] Malmi, T. and D. A., Brown. "Management Control Systems as a Package-Opportunities, Challenges and Research Directions." Management Accounting Research, Vol.19 (2008): 287-300.
[3] Simons, R. Levers of control: How Managers use Innovative Control Systems to Drive Strategic Renewal. Harvard Business School Press: Cambridge, 1995.
[4] Merchant, K. A. and W. A., Van der Stede. Management Control systems. Third Edition, Prentice Hall: England, 2007.
[5] Ghoshal, S and N. Nohria. "Internal differentiation within multinational corporations." Strategic management journal, Vol. 10, No. 4 (1989): 323-337.
[6] Martinez, J. I. and J. C., Jarillo. "Coordination Demands of International Strategies." Journal of International business studies, Vol. 22, No. 3 (1991): 429-444.
[7] Tseng, C. H., C. M., Yu and D. H., Seetoo. "The relationships between types of network organization and adoption of management mechanisms: An empirical study of knowledge transactions of MNC's subsidiaries in Taiwans." International Business Review, Vol. 11, No. 2 (2002): 211-230.
[8] Asada, T. and M., Tomo. "Strategic management and management and control in the new globalization era." Business Accounting, Vol. 68, No. 6 (2016): 1-8.
[9] Knights, D. and H., Willmott. "It's a very foreign discipline: The genesis of expenses control in a mutual life insurance company." British Journal of Management, Vol. 4, No. 1 (1993): 1-18.
[10] Abernethy, M. A. and Chua, W. F. "A field study of control system redesign: The impact of institutional processes on strategic choice." Contemporary Accounting Research, Vol. 13, No. 2 (1996): 569-606.
[11] Inoue, S. "The role of middle in the management and control system of medical institutions - a case study for a medium-sized hospital." Journal of the Japan Medical Business Association, Vol. 8 No. 1 (2014): 29-36.

Gender Diversity towards Organizational Effectiveness in an Oil and Gas Company

Lim Mei Ling[a], Robiah Ahmad[b], Norzaida Abas[c]

UTM Razak School of Engineering and Advanced Technology Universiti Teknologi Malaysia, 54100 Jalan Sultan Yahya Petra, Kuala Lumpur, Malaysia
[a]cathlim88@gmail.com, [b]robiah@utm.my, [c]norzaida.kl@utm.my

Abstract – *Gender diversity especially in engineering fields has been an interest in recent years. Studies claim the benefit reaped with gender diversity is important in terms of growth of an organization. This paper attempts to identify and investigate the perception of employees in an oil and gas company operating in Malaysia towards gender diversity and its relationship with attributes falling under organizational effectiveness by using a mixed method approach. The findings indicated that there are positive perceptions from engineers regarding gender diversity, however implementation in the company is still lacking. The gap is identified and a framework is presented as an integrated approach to gender diversity and emphasize that the context could only be achieved if all aspects are carried out strategically in an organization, as a whole.*

Keywords: Gender, Diversity, Organizational effectiveness, Engineering

1.0 INTRODUCTION

In organizations, the number of female engineers participating in the work force has increased substantially [1]. The emergence of gender diversity in corporate organizations are recently gaining popularity, knowing that organizations have to adapt to change and improve their goals by creating awareness, quality decision making and by changing the process as well as integration of teams. Many gender diversity policies however failed to address the issues of biasness and cultural change in the workplaces where numbers of women are made importance rather than equal opportunities of both genders [2-4]. Participation and talents are hardly retained throughout women's career progression [5]. Leaders and management will first have to understand why and how mixture of gender affects the workplace behaviour in terms of integration among engineers. The main focus is on the foundation of an engineering organization in understanding the relationship on how gender diversity promotes Organizational Effectiveness which in turns lead to better Organizational Performance.

The main objective of this study is to explore and identify the relationship between gender diversity in the effectiveness of an engineering organization in terms of its implementation and perception of employees and will be presented as a framework at the end of this study. With this, it will assist the organization to fully appreciate and communicate the role of gender diversity among their engineers. The execution of this study could benefit the industry by increase in awareness among engineers on the value and importance of cultivating gender diversity.

2.0 ORGANIZATIONAL EFFECTIVENESS AND GENDER DIVERSITY

Organizational performance gained popularity among researchers due to its tangible and quantifiable determinants. Though organizational effectiveness comes as secondary, however, it is a fundamental concern which all in all will impose effects onto the Organizational Performance of a company [6].

Competing Values Framework (CVF) provides a platform of dimensions and as a diagnostic tool to measure, understand and further develop an Organization's Effectiveness [7]. In this study however, measurement of Organizational Effectiveness will not be carried out. However, dimensions from CVF will be used as attributes to measure if gender diversity affects these determinants. There are 14 dimensions which are collaboration, engagement, innovation, adaptation, control, efficiency, consistency, aggressiveness, customer focus, stability, harmonious relations, new resources, competitiveness, and achievement [8].

Gender diversity is usually regarded as "women's" cause and men were more or less isolated from the whole agenda and process. However, the concept of gender diversity emphasized the principle of shared power and responsibilities between women and men which could only be achieved when men and women worked together in partnerships, and that the principles of equality of women and men had to be integral to the socialization process [9].

Since women make up roughly half of the global population, unlocking talents through gender diversity and inclusion initiatives could be the differentiating factor or a competitive advantage for the growth of companies [10]. Companies operating in Malaysia have begun to adapt the concept and provide encouragement to female engineers. The popularity of gender diversity does have its importance and has been proven by several studies as well as audit reports. Studies suggest that a diverse workforce will have a greater potential to thrive in certain organizational cultures and goals by having different viewpoints, ideas and market insights as well as understanding diverse customer groups [11].

3.0 METHODOLOGY

Research designed employed was a mixed method of quantitative and qualitative tools. The questionnaire is divided into 2 sections, the first section is regarding demographic and scope of respondents and Part 2 consist of adaptation of questions from an establish instrument by K. S. Cameron and Quinn [12]. The six point Likert scale was used to avoid neutral answers due to the subjectivity of the topic [13]. Population of engineers in Company A consist of roughly 800 engineers. A targeted sample size of about 250 respondents was chosen for this study [14]. Simple random sampling was used and 250 employees were randomly invited to participant in the survey, however only 77 survey forms could be used after filtration. The rule of thumb or a reasonable sample size for a correlation study was about 50 samples and therefore is acceptable for this study [15].

Following the survey, semi-structured interviews were conducted in order to understand and validate the results from the survey. The interview covers open ended

questions concerning the manager's perception and understanding on gender diversity as well as current trends in the market, follow up by the discussion on criteria taken from the survey result. The interviews ended with their opinions on gender diversity programs in the company and a feedback section to end the discussion. Purposive sampling was employed to focus on people with experiences in management. Four meetings, 2 men and 2 women with experiences of 13 to 30 years in the industry, were carried out in a face to face environment. Each interview lasted for about 40 to 45 minutes and was recorded and transcribed verbatim.

Data from the survey will be analysed using Minitab 17 statistical software. Descriptive statistics and Spearman-Rho Correlation will be used to assess the relationship between variables. The overall Cronbach's Alpha of the variables under study is 0.9372 and is considered acceptable for further analysis [16]. Thematic analysis was used on transcribed recordings.

4.0 RESULTS AND DISCUSSION

4.1 Employees Perspective on Gender Diversity

Majority of the respondents from Company A are male, with the percentage of 68.8%, while female respondents consist of 31.2%. This is parallel to the estimated population of Company A in terms of gender with 73% male and 27% female. The means for all 14 attributes are summarized in Table 1 below. Means above 4.0 shows strong agreement of engineers in the organization towards their perception that gender diversity could enhance these criteria in their work place and means less than 4.0 shows those engineers in Company A perceives that gender diversity has less or no effect on these attributes.

Table 1: Mean scores for organizational effectiveness attributes

Average Means Above 4	Average Means Equals Or Below 4.0
Collaboration (V1)	Control (V4)
Engagement (V2)	Achievement (V8)
Competitiveness (V3)	Stability (V9)
Innovation (V5)	Harmonious Relations (V10)
Efficiency (V6)	Aggressiveness (V11)
Adaptation (V7)	New Resources (V12)
Customer Focus (V13)	Consistency (V14)

4.2 Relationship between Variables of Organizational Effectiveness

Fourteen attributes of organizational effectiveness were assessed for associations. There were six significant relationships, with correlation coefficient of 0.71 and above, was found from Spearman's Rho correlation matrix and is summarized in Table 2. These findings were further probed during semi-structured interviews with managers in the company.

Table 2: Variables with strong correlation coefficient

Variables	Correlation Coefficient
Collaboration (V1) and Engagement (V2)	0.737
Achievement (V8) and Stability (V9)	0.759
Achievement (V8) and Harmonious Relations (V10)	0.730
Achievement (V8) and Aggressiveness (V11)	0.790
Stability (V9) and Aggressiveness (V11)	0.712
Harmonious Relations (V10) and Aggressiveness (V11)	0.795

4.3 Relationship between Gender Diversity and the attributes of Organizational Effectiveness

Based on the interviews, three main categories of eight themes were identified and summarized in Table 3. There was a clear distinction between the participants whereby female participants were more receptive of the gender diversity efforts and programs in the company, whilst the male participants showed little interest. For them, it was merely a context and salience of views between both groups of participants varied considerably.

Table 3: Summary of results from the interview sessions

Category	Sub-Themes	Summary
Category I: Manager's Perception on gender equality and gender diversity	Respect and acknowledgement	Values and strength that each gender could provide in a work force
	Local and international organizations	Culture which was adapted since this organization is a Multi-National Company and is directed by the main office in Europe
Category II: The Importance of gender diversity and its Implication in the Engineering Setting	Collaboration and engagement	Topic most often highlighted during all four conversations when participants were describing regarding their perceived benefits on gender diversity. Many associated with teamwork.
	Harmonious relations and achievement	Topic emerged although its frequency is not major
	Corporate image and marketing strategies	This show that the organization is matured and to promote the good image as a benchmark in the industry in terms of culture and social improvements, more than just profit and money
Category III: Implementation of gender diversity among Engineers	Over-Emphasis	Management imposed KPIs which creates bias and injustice, just to increase the gender balance in certain management level
	Training and coaching	Should be best given on candidates if targets were to be followed
	Flexibility	Will encourage more talent pools to stay with the organization

From the results, it is indicative that engineers do have that perception that gender diversity brings benefit during their daily work, majorly in terms of Collaboration and Engagement during the process of working together. This is in concurrence with other studies which supports the effect gender diversity brings onto a collaborative team, perhaps not only in engineering field, but in any situation involving discussions and decision making processes [10, 17].

However, it is imperative that the organization should implement the context of gender diversity carefully. Results show that some managers still have the idea that gender diversity is designed and catered for women only. In fact, the efforts work both ways especially for functional engineering departments which has more women than men. This study suggests a very simple framework, in Figure 1 below, that draws together three categories which was previously discussed.

Figure 1(a) is the framework of gender diversity towards organizational effectiveness where if the foundation is strong, the drivers will increase an organization's performance. While in Figure 1(b), meaning is the perception and understanding of engineers on gender diversity, purpose is the importance of implementing gender diversity and practices is the efforts and implementation made by the organization. All three categories interlock each other which mean it is vital for all three aspects to be made clear towards engineers as the largest population in Company A to understand, acknowledge and thus implement such context. Without any one, the context remains a context and implementation may fall short. It is important for one organization to properly educate and made aware of gender diversity as it is a construct which embeds deeply into working culture. More initiatives should be carried out by the organization in order to implement gender diversity, not only in certain levels of the organization but the organization as a whole, including junior engineers.

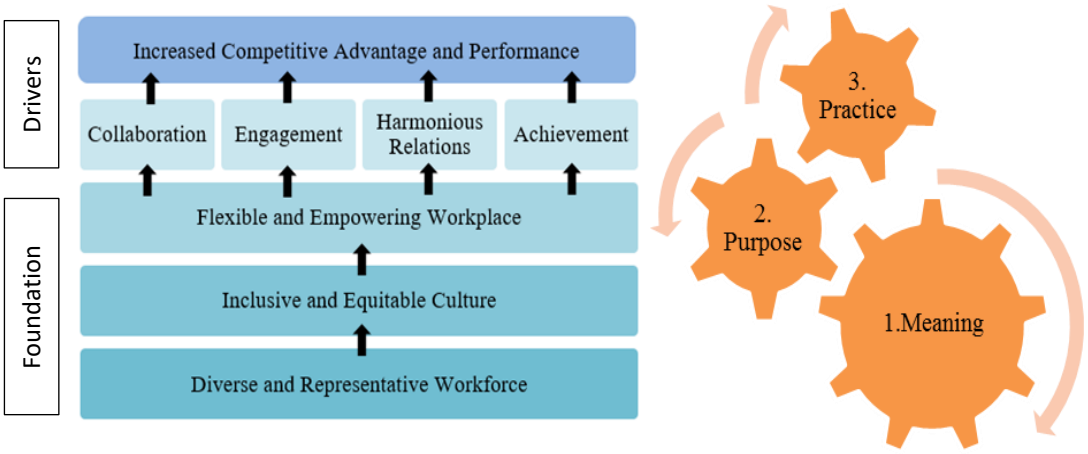


Figure 1: Framework for gender diversity and its implementation

5.0 CONCLUSION

This paper presents an inclusive review on gender diversity and its importance in an organization especially in an engineering environment of the oil and gas industry, which was usually highly regarded as male domineering. The results from Section 4.1 confirm that engineers do perceive the benefits of gender diversity, however understanding of its concept and importance is still vague based on the interviews. Through surveys and interviews, it was prevalent that there are correlations on gender diversity and the way it affects engineers at workplace. Therefore, it is of much importance for an organization to properly build the awareness in order to achieve and reap the benefits of gender diversity.

REFERENCES

[1] Johari, Husna, Norsiah Mat, Norazuwa Mat, Siti Norezam Othman, and Aini Hayati Mohamed. "Exploring career success among women engineers: The Malaysian case." International Journal of Education and Research (2013).

[2] Cech, Erin, Brian Rubineau, Susan Silbey, and Caroll Seron. "Professional role confidence and gendered persistence in engineering." American Sociological Review 76, no. 5 (2011): 641-666.

[3] Krizsan, Andrea, and Emanuela Lombardo. "The quality of gender equality policies: A discursive approach." European Journal of Women's Studies 20, no. 1 (2013): 77-92.

[4] Sharp, Rhonda, Suzanne Franzway, Julie Mills, and Judith Gill. "Flawed policy, failed politics? Challenging the sexual politics of managing diversity in engineering organizations." Gender, Work & Organization 19, no. 6 (2012): 555-572.

[5] Walker, Robyn C., and Jolanta Aritz. "Women doing leadership leadership styles and organizational culture." International Journal of Business Communication (2015).

[6] Richard, Pierre J., Timothy M. Devinney, George S. Yip, and Gerry Johnson. "Measuring organizational performance: Towards methodological best practice." Journal of management (2009).

[7] Ashraf, Giti. "A Review on the models of organizational effectiveness: A look at Cameron's model in." International Education Studies 5, no. 2 (2012): 80.

[8] Cameron, Kim. Organizational Effectiveness Wiley Encyclopedia of Management. John Wiley & Sons, Ltd., 2015.

[9] Marinova, Jivka. "Gender stereotypes and the socialization process." Brasilia, Brazil: United Nations and International Labour Organizations (2013).

[10] Badal, Sangeeta, and James K. Harter. "Gender diversity, business-unit engagement, and performance." Journal of Leadership & Organizational Studies 21, no. 4 (2014): 354-365.

[11] Adler, Emily Stier, and Roger Clark. An invitation to social research: How it's done. Cengage Learning, 2014.

[12] Cameron, Kim S., and Robert E. Quinn. Diagnosing and changing organizational culture: Based on the competing values framework. John Wiley & Sons, 2005.

[13] Chomeya, Rungson. "Quality of psychology test between Likert scale 5 and 6 points." Journal of Social Sciences 6, no. 3 (2010): 399-403.
[14] Krejcie, Robert V., & Daryle W. Morgan. "Determining sample size for research activities." Educational and Psychological Measurement 30, no. 3 (1970): 607-610.
[15] VanVoorhis, Carmen R. Wilson, and Betsy L. Morgan. "Understanding power and rules of thumb for determining sample sizes." Tutorials in Quantitative Methods for Psychology 3, no. 2 (2007): 43-50.
[16] Tavakol, Mohsen, and Reg Dennick. "Making sense of Cronbach's alpha." International journal of medical education 2 (2011): 53.
[17] Bear, Julia B., and Anita Williams Woolley. "The role of gender in team collaboration and performance." Interdisciplinary science reviews 36, no. 2 (2011): 146-153.

Comparative Studies between Japanese and Malaysian Students on Tourism Behaviour using Analytic Hierarchy Process

Ryuya Tabata[1,a], Rozzeta Dolah[2,b] and Norzaida Abas[2,c]

[1] School of Business Administration, Graduate School of Meiji University, 1-1 Kanda-Surugadai, Chiyoda Tokyo 101-8301, Japan
[2] Razak School of Engineering and Advanced Technology, Universiti Teknologi Malaysia, 54100 Jalan Semarak, Kuala Lumpur, Malaysia
[a]*ryuya.tabata@jfr.co.jp*, [b]*rozzeta.kl@utm.my*, [c]*norzaida.kl@utm.my*

Abstract – *Tourism is a very important industry for the economy of Malaysia and Japan, and both countries are experiencing an increase of foreign tourists. However, while there are many researches on tourist behaviours, no researches are conducted which directly compares Malaysian and Japanese tourists. In addition, although many influencing factors and process models have been proposed, there are few studies that comprehensively and quantitatively compared the tourist nationality. Realizing the lack of studies in this area, this study compared decision-making factors for travel destination selection comprehensively and quantitatively by using analytic hierarchy process (AHP) with Malaysian and Japanese students as samples. Consequently, a hierarchical model of comprehensive travel destination selection corresponding to AHP was constructed. Analysis showed that there are differences between Malaysian and Japanese students quantitatively, such as the individual constraints and the internal input importance are exactly opposite. Japanese students mainly travel for healing purposes while Malaysian students stated that travel expenses is their main constraint. In this research, there are two major theoretical implications. Firstly, based on travel place selection, this research identified the importance of each influence factor comprehensively and quantitatively by utilizing AHP. At present, only few analytical models comprehensively and quantitatively recognize the various influence factors using AHP. Secondly, this study is the first quantitative comparative study that focuses on Malaysian and Japanese students about decision making of choosing the tourism spot. The results of this research could be used for attracting Japanese student tourists to Malaysia and vice versa.*

Keywords: *Tourist behaviour, Analytic hierarchy process, Malaysian, Japanese, Nationality*

1.0 INTRODUCTION

There has been a steady increase in the number of foreign tourist visiting Malaysia and Japan after the restructuring of the Ministry of Tourism in Malaysia in 2004 and after the declaration of 'Japan: a sightseeing nation' by the Japanese Government in 2003 [1-2]. At present, tourism is the second biggest industry for Malaysian economy [3], while in Japan, tourism is one of few growing industry of Japan economy. Since tourism is of considerable important for both Malaysia and Japan this study focuses on the difference behaviour between Malaysian and Japanese tourist.

Tourist behaviour is one of the fields of tourism studies which originated from the study of consumer behaviour [4]. Influential factors is one the important area

concerning tourism behaviour [5]. According to Hashimoto, the influential factors of tourism behaviour can be separated into socio-demographic factors and physiological factors [6]. Pearce classifies socio-demographic factors into six categories, which are age, gender, nationality, expenditure, occupation, and education [7]. As for physiological factors, Sasaki categorize influence factors into two categories Push factor and Pull factor [8]. Studies by Pearce revealed 14 motive factors leading to a motive for travel [7]. Studies by Crawford and Godbey showed that interpersonal barriers, intrapersonal barriers and structural barriers would interfere with tourist behaviour [9]. Nakamura points out that there are six factors, namely lifestyle differences, language, planning/procedure, companion's absence, time and money, are constraints in choosing a destination [10]. Since there are many influential factors being proposed, there is a need for research on a process model to comprehensively assess the decision making of tourists [4]. Several process model studies have been conducted, a process model developed by Pearce regards travelers' decisions are determined by a combination of three factors; internal input, external input and individual constraints [7, 11-14]. There are several preceding studies which examine the differences in tourist behaviour due to differences in nationality. Studies by Pizam and Sussman compared the tourist behaviour of Japanese, German, Italian and American and pointed out the uniqueness of the Japanese [15]. Metin researched the differences of motivation factor of tourism between the two nationalities, British and German [16]. An examined the differences the tourism behaviour between the Japanese and Korean university students [17]. While there are many researches on tourist behaviours, no research are conducted which directly compares Malaysian and Japanese. In addition, although many influencing factors and process models have been proposed, there are few studies that comprehensively and quantitatively compared tourist nationality.

Realizing the lack of studies in this area, a comprehensive tourist behaviour model is used to compare Malaysian and Japanese quantitatively. In particular, an analytical method, namely the analytic hierarchy process (AHP) is chosen. The AHP has been shown to analyse ambiguous psychological factors as proposed by Saaty quantitatively by using hierarchical structure and pair-wise comparison [18]. As such, research objectives of this study are (1) to identify the criteria of tourists' preference and develop the hierarchy model according to the AHP and (2) to analyze preference criteria of Japanese and Malaysian tourists.

In this research, the scope is specified from three viewpoints of analysis method, sample and research field. AHP is used as an analytical method, due to using psychological factors for comparison and it's comprehensive and quantitative. University students in both Malaysia and Japan are used as samples. By doing so, study reliability could be improved by scoping samples, due to the fact that age, occupation, education and expenditure influenced tourist behaviour. Furthermore, because there are many previous studies focused on decision making for choosing tourism spot.

2.0 METHODOLOGY

2.1 Analytic Hierarchy Process

Analytic Hierarchy Process, developed by Saaty in 1971-1975, is the main analysis method of this research. For a long time, people had been concerned with the measurement of both physical and psychological factors. The AHP calculates an importance feature called “Weight” using a pair-wise comparison with a hierarchical model consisting of “Goal”, “Criteria”, and “Alternative”. The value of weight means the influence of each factor on the sample or sample group [19]. Therefore, The AHP is developed to measure both the physical and psychological factors comprehensively and quantitatively [20-22]. Details of analysis such as calculation method are not described because they are not the purpose of this research.

2.2 Sample and Materials

In this study, a pair-wise comparison questionnaire survey is conducted for AHP on Malaysian and Japanese students. The number of collected samples is 101 from Malaysian students and 107 from Japanese students. However, the number of valid samples is 69 and 63 respectively. Each survey was conducted at a local university (UTM, Meiji University, Nihon University) by the form of face to face or distribution.

Weight of AHP was calculated by the Eigen-value method, and the value of group decision was calculated by Saaty’s statistic method (geometric mean method). [18] Factor analysis was carried out with varimax rotation. Calculation of AHP is derived by using simple AHP analysis tool "Easy AHP Ver. 2.03 Rev. 4" provided by MYKA Institute. [23] For basic statistics and other analyzes, open system “R version 3.2.4 (2016-03-10)” for statistical BI tool was used. [24]

2.3 Analysis Model

The analysis model of AHP has a hierarchical structure namely “Goal”, “Criteria”, and “Alternative”. Goal means the purpose of the model, so in this research it is "choosing tourism spot". Alternative means options for Goal, but in this research it is "Malaysia" and "Japan". Criteria means influence factors from Goal to Alternative. In the first hierarchy of Criteria "Internal input", "External input", "Individual constraints" are chosen based on Pearce's process model [7]. In the second hierarchy of criteria, six factors, "Remove-anxieties", "Growth", "Pleasure", "Healing", "Personal-relation", "Pleasure", "Healing" and “Local-interest” extracted using factor analysis from 14 motive factors of Pearce under internal input, under external input, Kotlar's four personal factors "Personal information", "Commercial information", "Public information", and "Experiencial information" are selected as information sources for forming a destination image, under individual constraints, three factors are identified, namely "Intrapersonal barriers", "Internal barriers" and "Stractual barriers" with reference to Crawford and Godbye's research [7, 9, 24]. In addition, referring to the preceding research, the supplemental third hierarchy tied to the second hierarchy was set 29 factors [7, 10]. Therefore, Table 1 shows the list of all criteria in this study.

Table 1: The list of all criteria in this study

First Hierarchy (3)	Second Hierarchy (12)	Supplemental Third Hierarchy (29)
Internal input	Remove-anxieties	Recognition, Relationship (security)
	Growth	Self-actualize, Self-development (personal development)
	Pleasure	Stimulation, Novelty, Nature
	Healing	Isolation, Nostalgia, Escape/relax
	Personal-relation	Relationship (strengthen), Autonomy
	Local-interest	Self-development (host-site involvement)
External input	Personal information	Family, Friends, Others
	Commercial information	TV commercial, Magazine/catalog, Internet advertising
	Public information	TV program/news, Newspaper, Internet media
	Experiential information	Past traveling and examine the destination
Individual constraints	Intrapersonal barriers	Lifestyle, Language, Planning/procedure
	Interpersonal barriers	Companion absence
	Structural barriers	Time, Money

3.0 RESULTS AND DISCUSSION

Figure 1 shows result of the hierarchy analysis model in this study. In the first hierarchy, for Malaysian student, weight/importance is high in the order of Individual constraints (0.553), External input (0.261) and Internal input (0.187). In contrast, importance is high in the order of Internal input (0.458), External input (0.301) and Individual constraints (0.204) for Japanese student. Each level of importance in the second hierarchy is as shown in Figure 1, but there were six factors of Growth, Healing, Pleasure, Personal-relation, Interpersonal barriers and Stractural barriers that confirmed a significant difference ($P < 0.05$) in the results of t-test between Malaysian students and Japanese students.

The features of Malaysian students that could be identified from the results are the following four items; (1) extremely large impact of Individual constraints (about 55% influences), (2) among the constraints, the impact of money is the largest and it is about 20% of the total, (3) the importance of Internal input is relatively low, and there are many variations, so it is difficult to find features, and (4) emphasize experiential information sources compared with other information sources in image formation of travel destinations (external input).

On the other hand, the feature of Japanese students that can be grasped from the results are the following four items; (1) the most important factor in traveling is internal input. (about 46% influence), (2) among the Internal input, Japanese students have a particularly strong tendency to seek healing from travel, (3) due to grow up in a closed environment, tend to resist the diversity of lifestyle, and (4) utilize various information sources in a balanced fashion to select travel destinations.

The difference of tourist behaviour related to choosing tourist spot between Malaysian and Japanese students considered from the above results and features. First, Japanese students emphasize Internal input first, while Malaysian students emphasize Individual constraints primarily when choosing the tourism spot. Second, as a motive for traveling, Japanese students tend to demand more healing and relationship strengthening than Malaysian students. Third, for Malaysian students, travel expenses are 10 times more influential than Japanese students. Fourth, differences in lifestyle such as religion, politics, diet, etc. does not significantly affect the degree of influence on Malaysian students and Japanese students (process/reason might be different). Lastly, there are no major differences between Malaysian students and Japanese students regarding information sources for choosing destination.

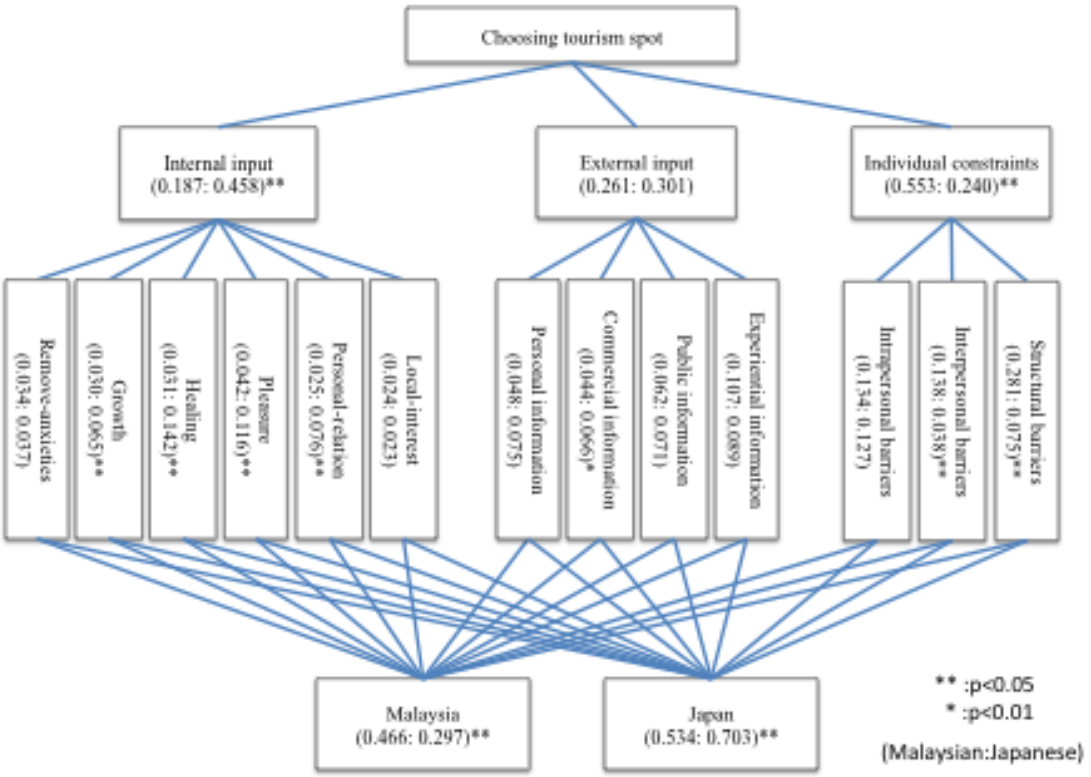


Figure 1: The result and hierarchy analysis model in this study
(Malaysian n=69, Japanese n=63)

4.0 CONCLUSION

Tourism is a very important industry for the economy of Malaysia and Japan and both countries are experiencing an increase of foreign tourists. A comprehensive tourist behaviour model correspondence to AHP is constructed to compare quantitatively Malaysian and Japanese tourists. This study is limited to using university students of both countries as samples. Among the items being compared are the characteristics such as traveling place selection, and clarified the difference in travel behaviour. Results reveal that the individual constraints and the internal input importance are

exactly opposite, Japanese students asked for traveling to healing while Malaysian students is thinking ten times the travel expenses problem.

In this research, there are two major theoretical implications. Firstly, based on travel place selection, this research identified the importance of each influence factor comprehensively and quantitatively by utilizing AHP. At present, only few analytical models comprehensively and quantitatively recognize the various influence factors using AHP. Secondly, this study is the first quantitative comparative study which focuses on Malaysian and Japanese students about decision making of choosing tourism spot. The results of this research could be used for attracting Japanese student tourists to Malaysia and vice versa. It was found that the most important factors for Japanese students are internal input, specifically healing. Malaysia with many wonderful resort areas such as Langkawi, Borneo and Redang are attractive to Japanese students seeking healing. On the other hand, ethnic and religious diversity is one of Malaysia's greatest attractions, however the diversity of lifestyle is restricted condition for Japanese students and results to be taken. Although Malaysia's advertisement in Japan seems to bring out diversity to the utmost extent, it may be necessary to review it. In this way, this research can be utilized for various practical marketing measures.

There are three limitations in this research. Firstly, due to the problem of the reality of the number of samples, the criteria for CI less than 0.15 are met only in the first hierarchy. Secondly, to calculate the representative values of Malaysian and Japanese students, this research need a few more samples. Thirdly, the questionnaire contents of this research are different from some Malaysian and Japanese students. However, they are adjusted using ratio and normalization. Finally, it is recommended to improve the reliability of the results and model by increasing the number of samples. Then, cluster analysis to classify Malaysian and Japanese can be used and further comparative research can be developed using samples of other nationalities.

REFERENCES

[1] An, J. "A comparison of overseas tourism behaviour between japanese and korean university student." Hiroshima University HU-Journal 8, no. 91-93 (2013): 1881-7696.

[2] Afihah Hanim Md Pazil and Azlinda Shuaib. "Students preferences using analytical hierarchy process (AHP) approach in selecting Malaysia tourism Destination." Universiti Malaysia Kelantan (UMK), 2014.

[3] Crawford, D. W., and G. Godbey. "Reconceptualising barriers to family leisure." Leisure Sciences, 9 no. 2 (1987): 119-127.

[4] Hashimoto Toshiya et.al. "Kanko-gaku zensyuudai4syuu tourist behaviour." Tokyo, Hara-syobou, 2013, ISBN: 4562091911.

[5] Hatanaka, T and Uosaki, K. "Personalized tourism information system using analytic hierarchy process." 22nd Fuzzy system symposium, Sapporo, Sept.6-8, 2006.

[6] Indrani, B and Saaty, T. "Group decision making using the analytic hierarchy process." Math Computing. Modelling Vol.17, no. 4/5 (1993): 101-109.

[7] Japan National Tourism Organization (JNTO); http://www.jnto.go.jp/jpn/

[8] Kotler. P and Zaltman. G. "Social marketing: An approach to planned social change." Journal of Marketing,Vol.35, no. 7 (1971): 3-12.
[9] Mansfeld. Y. "From motivation to actual travel." Annals of Tourism Studies 19, no. 3 (1992): 399-419.
[10] Metin, K. "Comparative analysis of tourist motivations by nationality and destination." Tourism Management 23 (2002): 221-232.
[11] Mohd. Motasim. A. K. "Tourism development in Malaysia: A review on government plans and policies." ACME International Journal of Multidisciplinary Research 1, no. 12 (2013), ISBN: 2320-236X
[12] Moutinho, L. "Consumer behaviour in tourism." European Journal of Marketing 21, no. 10 (2013): 5-44.
[13] MYKA R & D Laboratories; http://hp.vector.co.jp/authors/VA008899/MYKA_Lab/utility-j.html
[14] Nakamura Tetsu. "Constraints on overseas travel by Japanese young adult." Tamagawa University Tourism Department 2013 (1) 1-22, 2014-12.
[15] Okata Yuko. "An overview of the destination choice models in tourism." Tokai University Fukuoka junior college volume 6, 2006.
[16] Pearce, P. L. "Tourist behaviour: Themes and conceptual schemes." Channel View Publications, Clevedon, UK, 2005.
[17] Pizam, A and Sussman, S. "Does nationality affect tourist behaviour?" Annals of Tourism Research 22, no. 4 (2005): 901-907.
[18] R. W. Saaty. "The analytic hierarchy process what it is and how it is." Mathematical Modelling, Volume 9, no. 3-5 (1987): 161-176.
[19] Sasaki Toshij. "Psychology of tourist behaviour." Osaka; Kansai university publishing department, ISBN: 4873543002, 2000.
[20] Scott A. C, Girish P and Miguel M. "Consumer behaviour in tourism: Concepts, influences and opportunities." Current Issue in Tourism 7, no. 10 (2014): 872-909.
[21] The R Foundation; https://www.r-project.org.
[22] Tourism Malaysia; http://mytourismdata.tourism.gov.my/file://localhost/Malaysia Tourism.
[23] Van Raaji W. F. "Consumer research in tourism." Annals of Tourism Research 13, no. 1 (1986).
[24] Wahab, S., Crampon, L.J and Rothfield, L.M. "Tourism Marketing." London: Tourism International Press, 1976.
[25] Xia, W. et al. "How smart is your tourist attraction? Measuring tourist preferences of smart tourism attention via a FCEM-AHP and IPA approach." Tourism Management 54 (2016): 309-320.

Review on Implementation of Lean Management Techniques in a Dairy Manufacturing Industry

Sharmini Jegachandra[a] and Sha'ri Mohd Yusof[b]

UTM Razak School of Science and Advanced Technology, Universiti Teknologi Malaysia, 54100 Kuala Lumpur, Malaysia
[a]sharminijegachandra@gmail.com, [b]shari@utm.my

Abstract – *The purpose of the paper is to improve productivity in food manufacturing industry, particularly in a dairy manufacturing industry through minimization of waste using lean technique. The aim of this paper is to identify key area of waste across dairy manufacturing, to evaluate the factors causing the waste and to propose countermeasure in overcoming waste elements for continuous improvement in the company. By utilising Gemba walk, observation and interview, it has been identified that defective cans, excess inventory and waiting are key waste in the dairy manufacturing industry that need to be removed. Suggestion to mitigate this waste issue includes installation of material requirement planning software to prevent unnecessary production, redesign and resetting of machine to curb defective cans as well as regular maintenance to avoid unnecessary waiting time. It is concluded that by taking the right action, presence of waste can be eliminated from a process.*

Keywords: Lean implementation, Dairy manufacturing, Food industry, Gemba walk and interview

1.0 INTRODUCTION

The food manufacturing industry also commonly classified as a process industry involves a number of operations to transform raw materials into finished products. The food industry has a number of unique characteristics which makes it inherently different from assembly operations, and even other processing-type industries. First, being a base of heterogeneous gathering of items with distinctive degrees of perishability, and differed producing lead times, the food manufacturing industry is much bigger and complex. Second, the vast variety in nature of raw materials and their very unusual supply and also unpredictable customer requests make the assembling area entirely one of a kind. Because of its uniqueness of each product, these processes tend to add steps or more processes to meet the criteria and requirement. These processes sometimes are not necessary and do not add value to the end product. In fact, it only incur more cost for the process to take place which may contribute to waste in term of energy, time, human resource and cost.

Waste reduction is a process towards lean implementation. Use of lean management is classified for organizations to meet its objective as its point is to distinguish and evacuate each action in configuration, generation and inventory network administration related procedures that does not include esteem from the client's perspective [1-4]. Although lean is a well-established system, it does not appear to have an agreed upon approach for implementation in other manufacturing industry.

The unique characteristics of products and/or processes in processing industries such as large and inflexible machinery, long setup time, small batch sizes and resource complexity, offers a great challenge to the application of lean in food manufacturing industry. Though some studies show that a straightforward adoption of lean manufacturing in the food processing industries might not bring the desired efficiency gains [5], many others have proofed that with the right method, lean can be utilized to improve the process of a food manufacturing industry by minimizing the waste available to meet the customer's requirement [6-10].

In order to curb presence of non-value added process across food manufacturing, a case study is conducted in a dairy manufacturing company as an attempt to improve productivity through minimization of waste using lean techniques. Therefore, the research objectives to identify key area of waste across dairy manufacturing, to evaluate the factors causing the waste and to propose countermeasure in overcoming waste elements for continuous improvement in the company. The outcome of this research is expected to guide the development of an improved optimum process.

2.0 METHODOLOGY

The research was conducted by doing an extensive literature review on Lean Manufacturing Practices in general. Then the research was continued with the collection of data using instruments such as document reviews, interviews and observations. The current performance of the company is monitored by conducting with the seven waste assessments. The data collected is then analysed with lean tools and techniques such as flow charts, why-why analysis, cause and effect diagram to extract information and define problem statement. The analysed data is then used as suggestive corrective action for process improvisation.

The data is collected by adopting few methods. The first methodology is extensive literature view through internet and valid website on concept of Lean Production System and waste identification using tools of lean production system. Next, observation and document review is done at the site chosen where documents on the processing flow, waste handling are reviewed. Following that, an interview guide is prepared to gain more detailed information about the company with regards to their suppliers, customers and processes. Open ended questions are prepared for greater understanding of the company and the way in which each of the processes played a part in the manufacturing of the product. Finally, a Gemba walk is conducted on the current performance in the production floor. The Gemba walk is to identify the existing seven wastes such as motion, defect, overprocessed, overproduction, waiting, and transportation and inventory wastes and to highlight the critical area that need for process improvement.

3.0 RESULTS AND DISCUSSION

This section describes the processes that took place throughout the factory and identifies problems and issues faced by the company and will suggest solutions to these issues.

By means of observation, Gemba walk and interview, the process of sweetened condensed milk is collected and summarized as below:

(1) Raw materials on arrival of site go through quality check and received by R&D department. These raw materials are then categorized according to batch recipe and quantity before being stored in the raw material storage area.
(2) When is required for processing, these materials are then sent to the processing area, where materials are dumped into mixing tank, added with water, palm oil, vitamin, food conditioning, fat dosing and lactose dosing before being stored in recombination tank.
(3) The raw milk mixture is then standardized, homogenized and pasteurized.
(4) The processed milk is then transferred to crystallization tanks through heat exchanger where temperature is reduced by cooling.
(5) The crystallization tanks are connected to the filling machines and the mixture is pumped into can, sealed, date stamped and labelled before arranged into cartons.
(6) The labelled cans are arranged into carton, sealed and carton coded before being shrink wrapped and arranged on pallet for dispatch.

Once the data collected is summarised and mapped according to the actual process layout, key problematic areas are identified and possible solutions to mitigate the solution is proposed. The first issue seen is the dented cans before can coding and labelling. The root cause of this issue is identified to be the poor design and setting of the machine which leads to massive amount of defective canned milk. Rough welding point and rough turning at the mass conveyor results in the cans colliding and cause dents. Apart from that, the high conveyor speed at mass conveyor and level setting that resulted in overshoot of cans causes the cans to collide with each other and the machine which impact it shape and filled milk quality. This leads to the production being halt in order to recollect the entire defect product and reprocess the milk which is non-value adding. Figure 1 below shows the cause and effect diagram of defect waste.

The next issue seen in the company is the presence of excess inventory. Finish goods fills up the entire storage area where some of the goods are arranged along the production pathway due to lack of space. By using tools such as cause and effect diagram and why-why analysis, the root cause is identified. It is seen that the main issue for excess inventory is due to lack of automated system to control production. The absence of material required planning (MRP) system leads to poor planning and task prioritisation. This resulted in some of the products to be made beforehand and stored up to a month or two prior. And since the company runs on 24 hours production, the finished good that cannot be fit into the storage area are just aligned along the production pathway.

The third issue identified in the process is the waiting waste. This happens due to poor machine design, where machines are old and work in slow pace especially in can carton area. The lack of study, lack of interest and lack of expertise to improve the process results in high waiting time for the cans to be packed in carton and inspection before palletising. This leads to non-value added time where in realty the time taken

can be shorten with right measurement taken. The lack of maintenance also results in machine breakdown to often occur that leads to waiting waste.

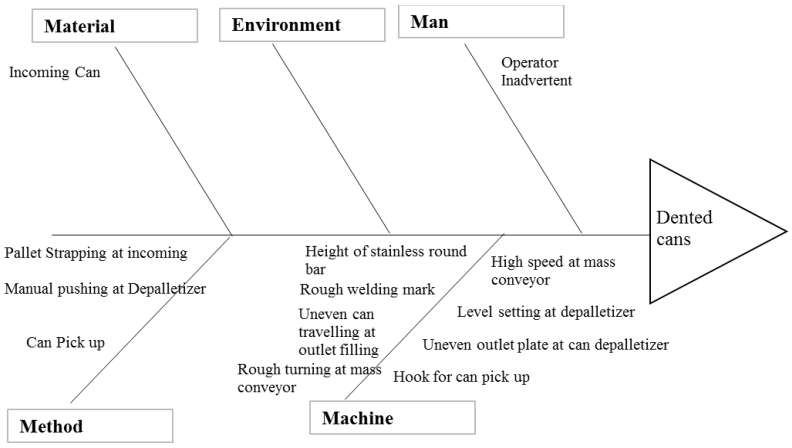


Figure 1: Cause and effect diagram

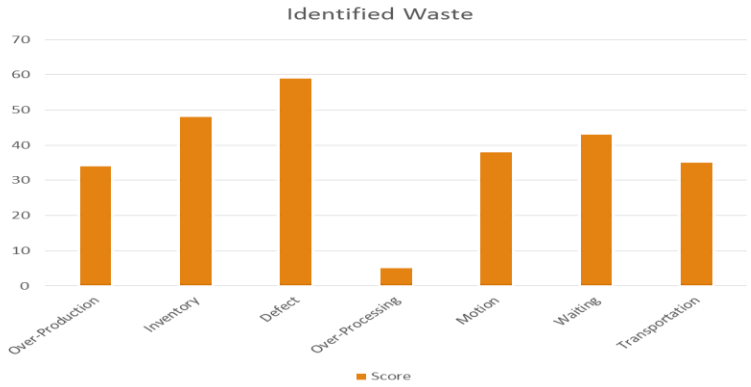


Figure 2: Identified waste across production department

As the issues and its root causes have been identified, solution can be proposed to mitigate the main issues in the dairy manufacturing industry. Table 1 shows an example of root cause and proposed solution for one key waste. First off, defective cans, this can be done by redesigning and resetting the machine where rough turnings at mass conveyor changed to roller bar guide and rough welding marks are smoothen and even out. As for the settings, reducing the conveyor speed and installing sensor reduces the collision between cans and reduces number of dented cans.

As for in order to reduce inventory waste, it is suggested for the company to get a material requirement planning (MRP) software installed as this will help in proper planning and task prioritisation. Having MRP software notifies the purchasing team to replenish finishing items and planning team to plan production properly that would eliminate unnecessary inventory.

Table 1: Root cause and proposed solution for defect waste.

No	Root Cause	Proposed/Action Plan
	Material	
1	Incoming Can (dented),layer pad, strapping, stretch film)	Communicate with supplier for "zero dented cans"
	Method	
2	Pallet Strapping (Incoming can)	Complete income check at warehouse receiving
3	Manual pushing cans at can depalletizer	Widen the pusher and reduce its weight
4	Can pick-up	WI on proper way of pick up
	Machine	
5	High speed conveyer at mass conveyer	Reduce speed of conveyor
6	Level setting (overshoot) at can depalletizer	Install sensor
7	Uneven outlet plate at can depalletizer	Change stainless steel base to wooden base
8	Hook for can pick up	Reduce weight of pick up
9	Height of the S/S round bar side guide/not straight	Standardize bar height
10	Rough welding mark	Smoothen and even the rough welding marks
11	Uneven can travelling at outlet filling room twist and before labeller	Straighten the guide
12	Rough turning at the mass conveyer	Change to roller bar guide
13	Seperator for 2 lines	Change the roller to eliminate dent
	Man	
14	Operator inadvertent	Create WI for operators; On line training

The waiting waste takes place due to the machine in carton coding being old and outdated. A proper way to mitigate this issue would be by implementing preventive maintenance. Regular and routine maintenance schedules need be in place to reduce machine errors, down time and minimise waiting waste. Operators could assist by helping to develop maintenance strategies and in certain cases carry out small tasks such as routine inspections and cleaning.

4.0 CONCLUSION

This paper presents an inclusive review on the implementation of lean management techniques in a dairy manufacturing industry. The paper discusses the process of manufacturing sweetened condensed milk and major waste issue that need to be tackled. Based on observation, Gemba walk and interview, it is found that the major issue in the selected manufacturing industry is presence of excessive inventory, defective canned product and waiting waste. Further analysis of study determines that taking appropriate action can help in curbing issues which are non-value added. For instance, installation of material required planning software is expected to reduce the production and storage of unnecessary inventory.

REFERENCES

[1] Abdulmalek, Fawaz A. and Jayant Rajgopal. "Analyzing the benefits of lean manufacturing and value stream mapping via simulation: A process sector case study." International Journal of Production Economics 107, no. 1 (2007): 223-236. doi:10.1016/j.ijpe.2006.09.009.

[2] Aljunaidi, Alla and Samuel Ankrak. "The application of lean principles in the fast moving consumer goods (FMCG)." Journal of Operations and Supply Chain Management 7, no. 2 (2014): 1. doi:10.12660/joscmv7n2p1-25.

[3] Parry, G. C. and C. E. Turner. "application of lean visual process management tools." Production Planning & Control 17, no. 1 (2006): 77-86. doi:10.1080/09537280500414991.

[4] Mahalik, Nitaigour P. and Arun N. Nambiar. "Trends in food packaging and manufacturing systems and technology." Trends in Food Science & Technology 21, no. 3 (2010): 117-128. doi:10.1016/j.tifs.2009.12.006.

[5] Cox, Andrew and Dan Chicksand. "The limits of lean management thinking." European Management Journal 23, no. 6 (2005): 648-662. doi:10.1016/j.emj.2005.10.010.

[6] McIntosh, R. I., J. Matthews, G. Mullineux, and A. J. Medland. "Late customisation: Issues of mass customisation in the food industry." International Journal of Production Research 48, no. 6 (2010): 1557-1574. doi:10.1080/00207540802577938.

[7] Melvin, A and David Baglee. "Value stream mapping: A dairy industry prospective." In Engineering Management Conference. IEEE Xplore, 2008.

[8] Anand, G. and Rambabu Kodali. "Selection of lean manufacturing systems using the analytic network process – A case study." Journal of Manufacturing Technology Management 20, no. 2 (2009): 258-289. doi:10.1108/17410380910929655.

[9] Hines, Peter, Nick Rich, and Ann Esain. "Value stream mapping: Benchmarking." An International Journal 6, no. 1 (1999): 60-77. doi:10.1108/14635779910258157.

[10] Wilson, Shellyanne. "Categorizing WIP inventories in the food industry." Journal of Agribusiness in Developing and Emerging Economies 3, no. 1 (2013): 27-48. doi:10.1108/20440831311321647.

Interactive Control Systems Generating Employee's Innovativeness with Case of Japanese Hotel Chain

Yohei Majima[1,a] and Sha'ri Mohd Yusof[2,b]

[1] School of Business Administration, Graduate School of Meiji University, 1-1 Kanda-Surugadai, Chiyoda Tokyo 101-8301, Japan
[2] Razak School of Engineering and Advanced Technology, Universiti Teknologi Malaysia, 54100 Jalan Semarak, Kuala Lumpur, Malaysia
[a]*majima@ken-suzuki.net*, [b]*shari@utm.my*

Abstract – *This study aims to determine key components of ICS effect on innovativeness and to clarify the role of leadership in Interactive Control Systems (ICS) with the case of Japanese hotel chain. Previous research on ICS claimed that it should be measured by variables along with multiple components and analyse the influence of each variables on innovativeness. As no related research to date therefore very few evidence about the ICS components more studies required to discuss the role of leadership. With qualitative and quantitative data in Japanese hotel chain this study able to provide additional verification of ICS components based on survey targeting employees, demonstrate of the effect of ICS components on innovativeness, and conclude test of the impact of leadership on ICS.*

Keywords: Management Control Systems, Interactive Control Systems, Innovativeness, Leadership, Japanese Hotel Chain

1.0 INTRODUCTION

Management Control is defined as the process that manager influence members for implement strategy [1]. Management Control Systems (MCS) are the systems to continue to this process. Traditional MCS, which are proposed by Anthony and Govindarajan [2] focus on motivated employees more efficient in the settled strategy. On the other hand, current researches discussed MCS have functions not only to facilitate efficiency, but also to prompt innovativeness [3]. Innovativeness means activities to propose and share ideas for improvement of products or services [2, 4].

Interactive Control Systems (ICS) that introduced by Robert Simons attract the attentions of researchers as one of the MCS prompting innovativeness [2]. The aim of ICS originally enables strategic renewal and innovation by stimulating dialog and debate throughout the organization [5]. In current research trend, the concept of ICS is extended. ICS are regarded as MCS motivation to enhance innovativeness, not only to implement strategic renewal and innovation [4, 6-8]. For example, previous empirical researches reveal that ICS have positive effect on financial performance through innovativeness [7].

Bisbe et al. [9] claim that ICS measurement methods in these empirical studies have limitation as the researches about ICS and innovativeness. According to their point of view, while ICS is measured by a single variable in the previous studies, ICS is a concept consisting of several components. Therefore, ICS needs to be measured by multiple variables along with each component. Otherwise, it is impossible to analyse the influence of each components on Innovativeness, and to identify the key components that promote Innovativeness.

As mentioned above, Bisbe et al. [9] points out analytical limitation to research on ICS and innovativeness. Following their point of view, researches begin discussion by focusing on the components of ICS. It is suggested that a series of prior studies are needed based on the components proposed by Bisbe et al. [9]. On the other hand, it seems that there is room for discussion as to whether ICS should be measured using the constituent elements indicated by Bisbe et al. [9], because there are no studies are conducted based on an interview survey targeting employees. Meanwhile, ICS is a mechanism to motivate innovativeness by promoting interactive communication between managers and employees. Therefore, it is necessary to verify the validity of the constituent elements of ICS by considering members in the survey target.

While accumulating previous research about the effect of ICS on innovativeness, some researches focus on leadership as influential factor of ICS. Hofmann et al. [10] reveal leadership has positive effects on ICS. Abernethy et al. [11] classify leadership into structural and consideration leadership, and demonstrates consideration leadership has the larger positive effect on ICS than structural leadership [11]. The researches have revealed that the relationship between innovativeness and ICS or ICS and leadership. However, no researches found demonstrating the whole relationships between leadership, ICS and innovativeness. This research aims to implement the empirical study with the case of Japanese hotel chain.

This paper aims to reveal key components of ICS effect on innovativeness and to clarify the role of leadership in ICS. As a step of analysis, the specific qualitative and quantitative survey are conducted in Japanese hotel chain A to obtain (1) additional verification of ICS components based on survey targeting employees, (2) to demonstrate the effect of ICS components on innovativeness, and (3) to test the impact of leadership on ICS.

2.0 THE ICS, INNOVATIVENESS AND LEADERSHIP

Henri [7] verified the effect of ICS on financial performance through innovativeness based on questionnaire surveys for top managers in the Canadian manufacturing sectors. As the result, it is supported ICS have positive effect on innovativeness, and innovativeness have positive effect on financial performance.

Moulang [8] demonstrated the influence of ICS on innovativeness through psychological empowerment with questionnaire surveys for middle managers in the Australian manufacturing industry. In the study, psychological empowerment is the autonomy of members on the business. His study reveals ICS influence psychological empowerment, and psychological empowerment facilitate to innovativeness [8].

Lopez-Valeiras et al. [4] tested the effect of ICS on the innovativeness based on questionnaire survey for top managers in the European manufacturing industry. His analyses support that ICS have direct positive effect on innovativeness [4].
Bisbe and Otley [6] have demonstrated that ICS have positive moderate effect on the relationship between innovativeness in the process of research and development, and financial performance with questionnaire surveys for top managers in the Spanish manufacturing industry. The results indicated that ICS facilitate the positive effect of innovativeness on financial performance.

Research that considers ICS components includes Bisbe et al. [9], Mundy [12], Nishii [13]. Previous studies [12-13] attempted to extend the five components shown in Bisbe et al. [9] Based on previous research reviews or case studies. For example, Mundy (2010) examines the components of ICS with interview survey in the European financial companies, and observes ICS in a Japanese hotel company to verify the five components of ICS.

From a series of these studies, it can be argued that these studies are carried out based on the five components proposed by Bisbe et al. [9]. Empirical researches about ICS published after their publications have shown that their definitions are often referred and are influential definitions. Bisbe et al. [9] examined the components of ICS based on previous research reviews on ICS, and as a result, five components are determined; (1) intensive use by top managers, (2) intensive use by middle managers, (3) face-to-face challenges and debates, (4) focus on strategic uncertainties, and (5) non-invasive, facilitating and inspirational involvement. They regarded leadership as one of the component of ICS. Intensive use by top managers and intensive use by middle managers are mean leadership of top and middle managers. They classify leadership into two types. Face-to-face challenges and debates is equivalent to communication opportunities. Focus on strategic uncertainties is related to sharing same direction among employees for innovativeness. Non-invasive, facilitating and inspirational involvement corresponds to empowerment [13].

Some researchers mention that leadership is characterised as an influential factor to ICS. For instance, Nishii [13] implies that leadership can be one of the factors affecting ICS with the case study of a Japanese manufacturing company. His research identified that top messages by top managers generate open communication for exchanging ideas among employees. However, Nishii [13] pointed out that it is necessary to increase a research site because he focuses on a case of one Japanese company only [13]. In addition, Hofmann et al. [10] verified the effect of leadership on ICS. They conduct a questionnaire survey for 440 manufacturing companies in Germany. As a result, they indicated leadership is positively related to ICS [10].

Abernethy et al. [11] classified leadership into initiating structure and consideration leadership. Initiating structure leadership is “the degree to which top management structures the work environment by implementing uniform procedures and by defining roles and responsibilities” [10]. Consideration leadership is “the degree to which a leader involves others in decision making, considers the opinions of subordinates, and shows concern for their well-being” [11]. They investigate 170 companies of manufacturing and service industries in Netherlands. Their results suggested that consideration leadership has a bigger positive effect on ICS than

initiating structure. As mentioned above, previous studies argued that leadership is a component of ICS. On the other hand, others mention leadership is regarded as one of influential factors to ICS.

3.0 METHODOLOGY

Three projects were carried out through the qualitative and quantitative survey. Project 1 aims to verify ICS components indicated by Bisbe et al. [9] based on analysis of text mining for employee's free response description (text data). For this analysis, text data collected using the free questionnaire survey carried out in fiscal year 2013 in Japanese hotel chain A. The questionnaire survey for 2013 was distributed to 7,152 employees, and the collected samples were only 1,716 (i.e., 24.0%).

The purpose of Project 2 is to demonstrate ICS with multiple variables according to multiple components and to verify the effect of ICS on innovativeness with qualitative data gathered from Japanese hotel chain A. For this analysis, the data is the employee questionnaire survey of fiscal year of 2014 at Japanese Hotel Chain A. The questionnaire survey was conducted for 8,080 employees, and 7,658 samples. Analytical model used in Project 2 is shown in Figure 1.

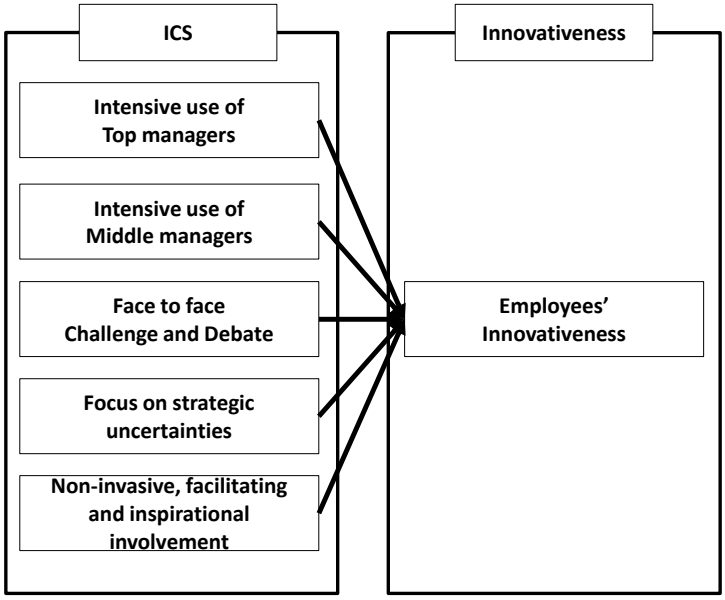


Figure 1: Analytical model in Project 2

In addition, Project 3 aims to reveal leadership effects on ICS and innovativeness. The analytical model for this project is shown in Figure 2. To examine the hypotheses (H1 and H2), a path analysis was carried out with data corrected from employees in a Japanese hotel chain A. The survey was conducted in the period of 2014 and the final sample contained 7,658 responses. Company A was chosen as the research site because innovativeness in the hospitality industry is more important than other industries. Hospitality industry workers should respond to customer request

extemporary. To fulfill the customer needs as soon as possible, workers have to improve their own task by themselves. Based on Bisbe et al. [9], intensive use of top and middle managers mean leaderships was regarded as influential factor of ICS [11]. It is the reason why three components without leadership are used as the indicators of ICS.

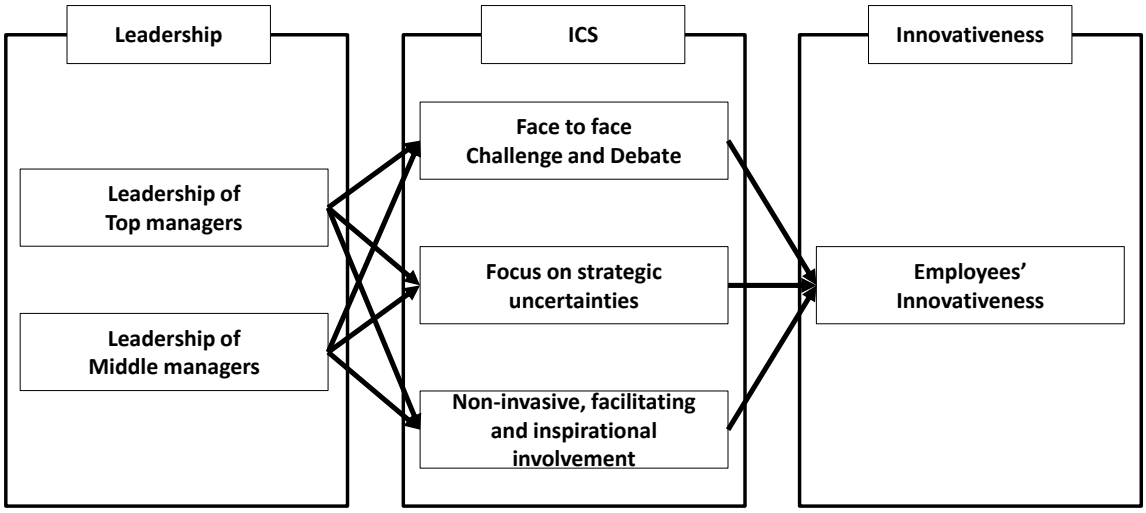


Figure 2: Analytical model in Project 3

4.0 RESULTS AND DISCUSSION

Table 1 shows the results of confirmatory factor analysis from the open-ended questionnaire survey. The results show frequency and portion of the four topics that are extracted as the components of ICS. To see the frequency of each topic, the highest frequency topic is face to face challenge and debates, this components means communication opportunity. The lowest frequency topic is non-invasive and inspirational involvement and the score is much lower than the others.

Table 1: Results of confirmatory factor analysis

Topic	Keywords	Frequency	Portion (%)
Face to face challenge and debates	Opportunity, meeting, debate, dialogue	386	40
Focus on strategic uncertainties	Direction, focus, common understanding	226	24
Intensive use of managers	Managers, boss leader, top-down	215	22
Non-invasive and inspirational involvement	Direction, responsibility, decision	133	14
		960	100

The results summarised in Table 2 indicate the co-regression analysis for innovativeness, in which all factors have shown positive effect on innovativeness. Face-to-face challenges and debates ($\beta = 0.278$), focus on strategic uncertainties ($\beta = 0.232$), and non-invasive, facilitating and inspirational involvement ($\beta = 0.198$) have $p < 0.001$, while intensive use by top managers ($\beta = 0.072$) and intensive use by middle managers ($\beta = 0.081$) have $p < 0.05$. Therefore, all independent variables showed a significant positive influence at the 5% level for innovativeness.

Table 2: Results of co-regression analysis for innovativeness

Factor	β	SE	t
Intensive use by top manager	0.721	0.17	0.538
Intensive use by middle manager	0.081	0.19	2.662
Face to face challenges and debates	0.278	0.19	12.768
Focus on strategic uncertainties	0.232	0.20	11.913
Non-invasive and inspirational involvement	0.198	0.18	9.863

Table 3 shows the results of confirmatory factor analysis and fit of analytical model. The results proposed model yielded a chi-square (x^2) of 2376.1 and 2575.5, respectively with 110 degrees of freedom. The root mean square error of approximation (RMSEA) is 0.054, confirmatory fit index (CFI) are 0.983 and 0.976, respectively. The overall fit of the model lays within acceptable levels (see Table 1 and 2).

Table 3: The results of confirmatory factor analysis and fit of analytical model for year 2014

Result	n	x^2	df	p	CFI	RMSEA
Confirmatory factor analysis	7,651	2,371.6	110	0.000	0.983	0.054
Fit of analytical model		2,575.5			0.976	

The results of path coefficients are shown in Table 4. The coefficients of face-to-face challenges and debates, focus on strategic uncertainties, and non-invasive, facilitating and inspirational involvement are 0.319, 0.280, and 0.348 respectively. All of them show positive effect on innovativeness with $p < 0.001$ and support the H1. In addition, leadership of top managers has positive effect on face-to-face challenges and debates, focus on strategic uncertainties, and non-invasive, facilitating and inspirational involvement when $p < 0.001$ and their coefficients are 0.527, 0.315, and 0.164, respectively. Leadership of middle managers also has positive effect ($p < 0.001$) on face-to-face challenges and debates, focus on strategic uncertainties, and non-invasive, facilitating and inspirational involvement with coefficients of 0.420, 0.316, and 0.328, respectively. These results support H2.

Table 4: Standardized parameter estimation of the analytical model

	n = 7,561	Coefficient
Face to face challenges and debates	⟨--- Intensive use by top manager	0.527
Focus on strategic uncertainties	⟨---	0.315
Non-invasive and inspirational involvement	⟨---	0.164
Face to face challenges and debates	⟨--- Intensive use by middle manager	0.420
Focus on strategic uncertainties	⟨---	0.316
Non-invasive and inspirational involvement	⟨---	0.328
Innovativeness	⟨--- Face to face challenges and debates	0.319
	⟨--- Focus on strategic uncertainties	0.280
	⟨--- Non-invasive and inspirational involvement	0.348

Referring to the coefficients of leadership to ICS, apparently leadership of top managers and leadership of middle managers have the largest effects on face-to-face challenges and debates. The results indicate leadership effects on making environment promoting frequent communication in workplace and have a commonality with the indication of Nishii [13]. The author reports that top managers' commitment to ICS build company's atmosphere to let employees communicate.

In comparison, the leadership of top managers and leadership of middle managers, the coefficients to non-invasive, facilitating and inspirational involvement are different. Leadership of middle managers has a bigger positive effect on non-invasive, facilitating and inspirational involvement than leadership of top managers. The non-invasive, facilitating and inspirational involvement means empowerment to employees. The role of middle managers is important in terms of empowerment because middle managers have more opportunities to involve in directly employees than the top managers. This result reflects the difference of how managers are related with employees.

5.0 CONCLUSION

This study has measured ICS by variables along with multiple components and analyse the influence of each variable on innovativeness. The qualitative and quantitative analysis used employee questionnaire survey data of Japanese hotel chain A to provide (1) additional verification of ICS components based on survey employees, (2) demonstration of the effect of ICS components on Innovativeness, and (3) test of the impact of leadership on ICS.

The results show top and middle managers' leadership have positive effect on ICS, and the ICS has facilitate to innovativeness. This study verifies the whole relationships between leadership, ICS and innovativeness. The findings have shown

important contribution to the employee's innovativeness. However, this study has two limitations. First, the data comes from one company and single year only. The findings may not discover the relationship between leadership, ICS and innovativeness continue over industries and years. Second, a further consideration about components of ICS is needed as this study only based on Bisbe et al. [9]. Other researchers may include other components of ICS for future studies.

REFERENCES

[1] Anthony, N. R. and V., Govindarajan. Management Control Systems (12th edition), Mcgrew-Hill/Irwin, New York, 2007.
[2] Chenhall, R. H. and F., Moers. "The role of innovation in the evolution of management accounting and its integration into management control." Accounting, Organizations and Society, 47, 1-13.
[3] Watanabe, S. and K., Ito. "Designing management control systems to facilitate the organizational learning: Toward a new paradigm of management accounting." The Journal of Cost Accounting Research, 26(1), 32-46, 2002. (In Japanese).
[4] Lopez-Valeiras, E., M. B., Gonzalez-Sanchezand J., Gomez-Conde. "The effects of the interactive use of management control systems on process and organizational innovation." Review of Managerial Science, 1-24, 2015.
[5] Simons, R. Levers of control: how managers use innovative control systems to drive strategic renewal. Harvard Business Press, 2013.
[6] Bisbe, J. and D., Otley. "The effects of the interactive use of management control systems on product innovation." Accounting, Organizations and Society, 29(8), 709-737, 2004.
[7] Henri, J. F. "Management control systems and strategy: A resource-based perspective." Accounting, Organizations and Society, 31(6), 529-558, 2006.
[8] Moulang, C. "Performance measurement system use in generating psychological empowerment and individual creativity." Accounting & Finance 55 (2), 519-544, 2015.
[9] Bisbe, J., J. M., Batista-Foguet and R. H., Chenhall. "Defining and measuring attributes of management control systems: A methodological note on the risks of theoretical misspecification." Accounting, Organizations and Society 32, 7(8), 789-820, 2007.
[10] Hofmann, S., A., Wald and R., Gleich. "Determinants and effects of the diagnostic and interactive use of control systems: an empirical analysis on the use of budgets." Journal of Management Control 23 (3), 153-182, 2012.
[11] Abernethy, M., J., Bouwens and L., Van Lent. "Leadership and control system design." Management Accounting Research, 21 (1), 2-16, 2010.
[12] Mundy, Julia. "Creating dynamic tensions through a balanced use of management control systems." Accounting, Organizations and society 35, no. 5 (2010): 499-523.
[13] Nishii, G. "The case study of budget management: From the view of interactive control systems " The Journal of Economic Studies (Osaka Prefecture University), 49 (3), 69-89, 2012. (In Japanese)

The Influence of Customer Satisfaction on Customer Retention at Perodua Service Centers in Ipoh

Siti Nurhidayah Abdul Shukor[a] and Nik Hasnaa Nik Mahmood[b]

UTM Razak School of Engineering and Advanced Technology, Jalan Sultan Yahya Petra, Universiti Teknologi Malaysia, 54100 Kuala Lumpur, Malaysia
[a]*dayaabdshukor@gmail.com*, [b]*nikhasnaa.kl@utm.my*

Abstract – *This paper discusses a study on the influence of customer satisfaction on customer retention in the automotive industry. The objectives of the study were to determine the level of customer satisfaction and retention, to examine the relationship between customer satisfaction and customer retention, to predict the impact of customer satisfaction on customer retention, and to understand after warranty lost customers' switching factors. Two sets of questionnaires were used to measure customer satisfaction adapted from J.D. Power Customer Satisfaction Index. Questionnaires were distributed to 350 Perodua customers who patronize the service at Perodua Service Centers in Ipoh and the interview was also conducted with the after warranty lost customers. Data were analysed using both descriptive and inferential statistics namely frequencies, mean, Pearson Correlation, and regression. The finding of the study showed that both customer satisfaction and customer retention score were at high level. The results of Pearson's correlation analysis showed positive and significant relationship between customer satisfaction and customer retention. In addition, regression analysis also showed that customer satisfaction contributed to 51% of customer retention. Recommendations for practice and future research were also discussed.*

Keywords: Customer Satisfaction, Customer Retention, Service Quality, After-sales service

1.0 INTRODUCTION

Competition of market in services companies within the same industry is becoming increasingly similar. Higher quality products, brand loyalty, and good after-sales services are being particularly considered by customers nowadays. Therefore, in order for an organization to remain competitive, the retention of a customer becomes an important area that needs to be of concern to ensure profitability of the business. In many service industries, they are having a problem to retain their after warranty customers and this is also happening in Perodua Sdn. Bhd. The current after warranty rate at Perodua service centers in Ipoh is 29% where the organization has set goals whereby the minimum achievement of after warranty rate at each Perodua service center should at least be 33%. Furthermore, survival in the current competitive struggle, rapid development of new technology, increasing needs and demand, and performance of good relationship with customers will contribute to higher customer retention as a satisfied customer is most likely to repurchase, which leads to increased sales and market share Rigopoulou et al. [1]. In order to achieve customer satisfaction, a good service quality provided is matching the specifications, a stage where consumer specifications are met; fair exchange of a value at a price and potential for utilization to achieve customer satisfaction in service, Kotler and Keller [2].

The research objectives can be further detailed as follows:
1. To identify customer satisfaction index of Perodua Ipoh's customers.
2. To determine the level of customer retention behavior.
3. To examine the relationship between customer retention and customer satisfaction.
4. To predict the influence of customer satisfaction on customer retention.
5. To understand the switching factors among after warranty lost customers.

2.0 LITERATURE REVIEW

2.1 Customer Satisfaction

Customer satisfaction is a well-known and established concept in several sciences. In general, customer satisfaction is a person's feeling of pleasure or disappointment that results from comparing a product's perceived performance to expectation, Kotler and Keller [2]. Andreassen and Lindestad [3], however, claimed that customer satisfaction is the accumulated experience of a customer's purchase and consumption experiences from the products and services. Therefore, Donovan and Samler [4] mentioned that customer satisfaction is influenced by two factors which are expectations and experienced service performance. Otherwise, customer satisfaction has a direct impact on an organization's performance and that expectations over time are brought in line with actual performance [5 - 6].

Customer satisfaction can also be defined as customers' overall evaluation of performance that has been offered to them. This positive overall satisfaction will give strong effects on customer loyalty as well as profitability to an organization as studied by Bowen and Chen [7]. Moreover, customer satisfaction is the direct effect of service provision, while the generated intentions, attitudes, and behaviors that follow are more long-term oriented in after-sales services. Since satisfied customers tend to maintain their consumption pattern or consume more similar products or services, customer satisfaction has become an important indicator of quality, future revenue, and customer loyalty [3].

2.2 Customer Retention

Customer retention or customer loyalty is an intended behavior in expressing their satisfaction related to the service or company and it includes how likely a customer is to provide positive WOM. In order to ensure customer retention, the organization must deliver good performance to them and one of service quality elements, reliability, is important as to deliver prompt service to the customers especially on promised time [20].

2.3 Relationship between Customer Satisfaction and Customer Retention

Organization can maintain their business effectiveness as long as they have satisfied and loyal customers [8]. It is necessary to provide and continuously improve customer satisfaction in order to achieve sustainable competition in the market. Bowen and Chen [7] found positive correlation between loyal customers and profitability where an organization should not only satisfy their customers but also provide extremely great satisfaction to be experienced.

A study by Tamuliene and Gabryte [9] proved that relationship quality is very significant to switching costs as a good relationship with the customers will satisfy them by increasing the emotional loss as well as being the key factors to retain them. Moreover, the study also indicated that good relationship with customers is important as it has the direct impact on customer satisfaction and customer retention.

3.0 METHODOLOGY

3.1 Research Design

This research involved both quantitative and qualitative methods in facilitating the data collection, which were preferable for a research to provide a better understanding of the research problems. Quantitative data were collected by a survey through the distribution of a set of questionnaire whereas qualitative data were collected through in-depth interviews.

3.2 Project Sampling

The total number of Perodua consumers in Ipoh district was 3,000 from two Perodua service centers and out of the 3,000 population, 350 of them were sampled based on the Krejcie and Morgan [11] sampling size table. In-depth interviews were conducted with 4 after warranty lost customers. In the context of this study, after warranty customer refers to a customer who owned the vehicle for more than 3 years or with the mileage of 100,000 km (whichever comes first), which included both existing and lost after warranty customers.

3.3 Instruments

Two instruments were used to measure customer satisfaction and customer retention. The customer satisfaction questionnaire was adapted from J.D. Power Customer Satisfaction Survey, which consists of 5 attributes known as Service Initiation, Service Advisors, Service Facility, Vehicle Pickup, and Service Quality. Customer retention questionnaire was adapted from Scott M. Smith (2012). A five-point Likert Scale was used to measure the customers' extent of agreement on both customer satisfaction and customer retention items. Cronbach’s alpha statistic was applied to examine the reliability of the two instruments used in this study. The overall Cronbach's Alpha of the variables in the study was more than 0.7 and was considered acceptable for further analysis.

A semi-structured interview was conducted to fulfill the qualitative data collection in order to understand and validate the results from the previous quantitative study. A set of interview questions was developed to understand the customers' experiences, perceptions, and also the factors that made them switch to other non-Perodua service centers.

3.4 Data Analysis

Data from the survey were analyzed using SPSS statistical software. Descriptive statistics (frequencies, mode, and mean) and inferential statistic (Pearson’s

Correlation and Regression) were used to assess the relationship between the variables and the influence of the studied variables. The acceptable value of correlation coefficient should be in the range of +1.0 (perfect positive correlation) to -1.0 (perfect negative correlation). The strength of correlation is based on Guilford rules of thumb [10].

4.0 RESULTS AND DISCUSSION

4.1 Customer Background

Out of 350 customers, 53.7% of them are male whereas 46.3% of them are female customers. Majority of the customers (66.9%) are Malay, followed by Chinese with 19.1% population. Furthermore, half of Perodua after warranty customers who still use the service at Perodua service centers are the ones using the Myvi model with 43.4% and 59.7% of the customers are using Perodua vehicles for 4-7 years.

4.2 Customer Satisfaction and Customer Retention Level

Five attributes of Customer Satisfaction were assessed to indicate the score of customer satisfaction level at Perodua service centers. The results showed a high score of mean (4.1) and it could be concluded that all customers were satisfied with the service provided at Perodua service centers in Ipoh. The mean score of customer retention at Perodua showed a high level of customer retention (Mean = 4.13).

4.3 Relationship between Customer Satisfaction and Customer Retention

The result of Pearson's correlation analysis showed a significant and positive relationship between customer retention and customer satisfaction. The r coefficient for this test = .697 as shown in Table 1, which shows that the strength of correlation is at a moderate level. The more the customers feel satisfied with the service, the higher the customer retention.

Table 1: Relationship between CS and CR Correlations

		MeanCR	CSI
MeanCR	Pearson Correlation	1	.697**
	Sig. (2-tailed)		.000
	N	350	350
CSI	Pearson Correlation	.697**	1
	Sig. (2-tailed)	.000	
	N	350	350

This finding is supported by a study conducted by Pantouvakis and Lymperopoulos [12], which also shows the moderate relationship of the two variables where the satisfaction of customer seems to be the repeated use of service and this can also be supported by a study conducted by Gustaffsson et al. [13] where customer satisfaction

has a positive effect on customer retention. The relationship between these two variables is one of the most popular topics among service researchers, where Bowen and Chen [14] and Jahanshahi et al. [15] found that there is a positive correlation between customer satisfaction and customer loyalty that directly affects the retention of customers. Jahanshahi et al. [15] pointed out that the positive relationship between these two variables will be a challenging task for an organization to pay attention to.

4.4 Influence of Customer Satisfaction on Customer Retention

The prediction on the influence of customer satisfaction on customer retention was analyzed using regression analysis. The adjusted R2 value was 0.506 which indicated that 51% of the variance in customer satisfaction contributed to customer retention. Moreover, a result from ANOVA test showed that there was a significant relationship between 5 attributes in customer satisfaction and customer retention where the F value was 72.933.

Table 2: Influence of CS on CR Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	T	Sig.
1	(Constant)	1.160	.183		6.326	.000
	MeanSI	.348	.056	.384	6.188	.000
	MeanSA	-.052	.063	-.049	-.823	.411
	MeanSF	.113	.052	.120	2.170	.031
	MeanVP	.282	.069	.307	4.115	.000
	MeanSQ	.045	.067	.048	.670	.503

a. Dependent Variable: MeanCR

It was found that among the five independent variables, Service Initiation (β=0.348), Service Facility (β=0.120), and Vehicle Pickup (β=0.307) were the most dominant factors in influencing the customers' retention in visiting Perodua service centers. For example, 1-unit increase in Service Initiation corresponds to 0.35-unit increase on customer retention.

This finding is consistent with a previous study done by Chang et al. [16], which stated that in order to build a long-term relationship with the customer to influence them to repurchase is by enhancing customer satisfaction. A previous study conducted by Jahanshahi et al. [15] also supports this study where their finding shows that better products and services will increase customer satisfaction as well as having the tendency to increase customer loyalty. According to Andreassen and Lindestad [3], customer satisfaction is the key to profitability where it can influence customer behavior to maintain their consumption pattern to repurchase the same products and services.

4.5 Switching to other non-Perodua Service Centres

The data from the in-depth interviews with 4 after warranty lost customers had identified four themes regarding the switching behavior among the customers. The said four themes are locations, business hours, perception (expensive), and lack of awareness of promotion, campaign, and packages.

Customers will easily switch to negative perceptions and this will result in low customer retention when their expectation is not met by the organization as supported by a previous study by Kang et al. [20]. According to the study by Kang et al. [20], customer perception can lead to negative WOM that will be spread by the dissatisfied customers and this will affect Perodua's future success and performance. These findings are also supported by Tamuliene and Gabryte [9], where the model used in this study had shown that there was a strong relationship between customer satisfactions and switching costs by which whenever the customers do not experience good services as in accordance with their expectation, they will then easily switch to other service providers and vice versa.

5.0 RECOMMENDATIONS AND CONCLUSION

5.1 Recommendations and Future Research

Since customer satisfaction has a positive correlation with customer retention, it is important for Perodua to always improve their customers' satisfaction from time to time. Customer behavior varies according to economy, environment, and also trend and it is vital for Perodua to not stay with the same current practices or condition of providing services to their customers.

The gap in switching factors on location-wise as claimed by the customers can be recommended by bringing the services to customers such as providing the mobile services to the customers. The current practice of mobile service is only implemented in East Malaysia region; thus, Perodua should consider extending the activities to other regions depending on the customer's demand on Units in Operations (UIO). On the business hour gaps, it is recommended that Perodua reviews the full working days on Saturdays and also adding an extension of services on Sundays to cater the working customers' demands. Finally, Perodua should grab the opportunity on the social media to promote their packages, promotion, and campaign in line with the latest trend rather than using the conventional method of promoting on radio and newspapers.

Future research for this study can extend the sample to other Perodua service centers in Malaysia. The larger sample that poses the similar questions would be more accurate. Secondly, an extension of under warranty customers can also be studied so that the organization can prepare for their retention of customers after the warranty period ends. The study can also be implemented in other service industries to evaluate their customer satisfaction and retention.

5.2 CONCLUSION

This study presents the results of relationship between customer satisfaction factor and retention of the customers in an organization. The results had shown that satisfied customers would positively influence the retention behavior of customers. Even though the results showed that Perodua had high scores in customer satisfaction and retention; however, there were a few gaps that needed to be of concern for the Perodua management in order to maintain and improve the level of their customers' satisfaction. The retention of customers would positively affect the profitability of organization and also market share where the improvement in customer satisfaction would also increase customer retention. Thus, it is essential for Perodua to solicit continuous feedback from their customers in order to capture some information regarding their experience, expectations, and to also assess the future needs to gain their high satisfaction in order for them to repurchase the products and services offered by Perodua.

REFERENCES

[1] Rigopoulou, I. D., Chaniotakis, I. E., Lymperopoulos, C., and Siomkos, G. I. (2008). After-sales service quality as an antecedent of customer satisfaction: The case of electronic appliances. *Managing Service Quality: An International Journal, 18*(5), 512-527.

[2] Kotler, P., and Keller, K. L. (2012). Marketing Management. *Prentice Hall, 14th Edition*.

[3] Andreassen, T. W., and Lindestad, B. (1998). Customer loyalty and complex services: The impact of the corporate image on quality, customer satisfaction and loyalty for customers with varying degrees of service expertise. *International Journal of Service Industry Management, 9*(1), 7-23.

[4] Donovan, P., and Samler, T. (1994). Delighting Customers: The Ten-step Approach to Building a Customer-driven Organization. *Managing Service Quality: An International Journal, 4*(6), 38-43.

[5] Kumar, V., Batista, L., and Maull, R. (2011). The Impact of Operation Performance on Customer Loyalty. *service science*, 158-171.

[6] Broetzmann, S. M., Mathieu, J. K., and Marwaha, R. J. (1995). Customer satisfaction – lip service or management tool? *Managing Service Quality: An International Journal, 5*(2), 13 - 18.

[7] Bowen, J. T., and Chen, S.-L. (2001). The relationship between customer loyalty and customer satisfaction. *International Journal of Contemporary Hospitality Management, 13*(5), 213 - 217.

[8] Aktepe, A., Ersöz, S., and Toklu, B. (2014). Customer satisfaction and loyalty analysis with classification algorithms and Structural Equation Modeling. *Computers & Industrial Engineering 86 (2015)*, 95-106.

[9] Tamuliene, V., and Gabryte, I. (2014). Factors Influencing Customer Retention: Case Study of Lithuanian Mobile Operators. *Procedia - Social and Behavioral Sciences, 156*, 447-451.

[10] Tompkins, C. A. (1992). "Using and Interpreting Linear Regression and Correlation Analyses: Some Cautions and Consideration." Clinical Aphasiology **21**.

[11] Krejcie, R. V., & Morgan, D. W. (1970). Determining Sample Size for Research Activities. Educational and Psychological Measurement, 30(3), 607-610.

[12] Pantouvakis, A. and K. Lymperopoulos (2008). "Customer satisfaction and loyalty in the eyes of new and repeat customers: Evidence from the transport sector." Managing Service Quality: An International Journal **18**(6): 623-643.

[13] Gustaffsson, A., et al. (2006). "The Effects of Customer Satisfaction, Relationship Commitment Dimensions, and Triggers on Customer Retention." Journal of Marketing **69**(4): 210-218.

[14] Bowen, J. T., and S.-L. Chen (2001). "The relationship between customer loyalty and customer satisfaction." International Journal of Contemporary Hospitality Management **13**(5): 213 - 217.

[15] Jahanshahi, A. A., et al. (2011). "Study the Effects of Customer Service and Product Quality on Customer Satisfaction and Loyalty." International Journal of Humanities and Social Science **1**: 7.

[19] Chang, P. L., et al. (2008). The Effect of Long-Term Customer Satisfaction on Customer Purchase Intention. New York, IEEE.

[20] Kang, B.-S., et al. (2007). "The Effects of Service Quality on Customer Satisfaction in The case of Dissatisfied Customers." Asian Journal on Quality **8**(1): 27 - 39.

Inventory Management in a Kitchen Hood Manufacturing Plant

Siti Rozita Sabar[a] and Abd. Rahman Abdul Rahim[b]

[1]UTM Razak School of Engineering and Advanced Technology, Universiti Teknologi Malaysia, Jalan Sultan Yahya Petra, 54100 Kuala Lumpur, Malaysia
[a]siti.rozita87@gmail.com, [b]rahmanar@utm.my

Abstract – *An inefficiency of inventory management is a common problem encountered by manufacturing industries. Researches in Supply Chain Management (SCM) over the last two decades are about Vendor-manage inventory (VMI) and Just-in-Time (JIT) method. The first objective of this study is to identify the current supply chain and inventory management practice between producer and suppliers. The second objective is to determine the inventory demand data that can be shared as information exchange data with the supplier. Finally, this study is to propose whether Vendor Manage Inventory (VMI) or Just in Time (JIT) methods can be implemented in this manufacturer to improve inventory management. The present study has been conducted in the kitchen hood manufacturer and their local suppliers. An interviews method, observation and literature review were conducted to collect the data. The finding is apparent that VMI and JIT could possibly implement in XYZ Manufacturing Sdn Bhd. Three recommendations have been suggested to solve the problem identified throughout the interview session. Even the research only cover kitchen hood manufacturing plant in Malaysia, this finding would be useful for the worldwide company.*

Keywords: Supply Chain Management, Inventory Management, Inventory Control, Vendor-managed Inventory (VMI), Just-in-Time (JIT)

1.0 INTRODUCTION

Inventory management becomes a fundamental part of supply chain management (SCM). SCM has in recent years become an important way to enhance the company's competitive strength and therefore an important issue for most companies. The inefficiency of inventory management is a common problem encountered by manufacturing industries. Manufacturing strategy has traditionally focused on the internal operations of manufacturing firms, in particular, on those concerned with the physical transformation while designing the inventory strategy, the firm must initiate internal integration by combining purchasing, production control and distribution [1]. Some organisations have various systems in place for Enterprise Resource Planning (ERP), replenishment strategies and various types of lot sizing techniques to manage inventory as well as to satisfy customer needs. However, they are still experiencing the problem of excessive or insufficient inventory [2]. High inventory will directly make corporate earnings expectation downgrade, and the turnover of capital turns slows [3]. A manager cannot keep too much inventory on hand because it will waste money storing and lose money if

inventories are damaged or stolen [4]. The rate of total cost reduction is a function of demand variability and production capacity [5]. Numerous research studies have performed on the inventory management driving by categorization method and inventory costing. However, there is vet little research has been conducted to analyse the possibility to implement the VMI or JIT simultaneously in one study. Thus, the purpose of this study is to identify the current supply chain practice between producer and supplier. Furthermore, this study has determined the inventory demand data that can be shared as information exchange data with the supplier. Finally, this study is to propose whether Vendor Manage Inventory (VMI) or Just-in-time (JIT) methods can be implemented in this manufacturing plant to improve inventory management.

The XYZ manufacturing continuously encounters the insufficient or excessive stock in inventory even though the most of the parts in inventory are supply by the local suppliers. The researcher found, there are no guidelines to advance the replenishment cycle and quantity data. Therefore, to avoid leakage of stocks, they are purchased in bulk and lumpy quantity and resulted keeping a huge inventory in stock. A manager cannot keep too much inventory on hand because it will waste money storing and lose money if inventories are damaged or stolen [6]. However, if the production line has not enough inventory stock to support the production process, shortage or emergency orders will be disrupting the production processes and will increase the back orders of the productivity and profit.

Regarding on Mateen [7], VMI is one of coordination mechanisms that has been gaining a lot of attention and been adopted by a diverse set of companies. Rahim [8] defined VMI is an inventory management policy in which the supplier assumes, in addition to its inbound inventory, the responsibility of maintaining inventory at the buyers and ensures that they will not run out of stock at any moment. Vendor-managed inventory (VMI) has been described by Hariga [9], that the supplier responsible for managing the inventory level at the buyer's place by determining the right timing and size of the orders. In many instances of VMI, the inventory is owned by supplier until it is sold by the buyer. The manufacturer makes forecasts, replenishment decisions and in some cases accepts inventory ownership until consumption of the stock [10]. In return, the control of the replenishment decision moves to the manufacturer instead of the buyer and the phase of the process are saved [11]. VMI requires the buyer to share demand information with the supplier to allow it to make inventory replenishment decisions [10] and suppliers can then use the information to plan production runs, schedules, and deliveries and manage order volumes and inventory levels at the buyer's stock keeping units [11].VMI assistances to improve manufacturer forecast and better match manufacturer production with final customer demand [12].

Just-in-time (JIT) production system, which originated implement by Toyota in the mid- twentieth century [13] has been accepted globally as one of the effective manufacturing strategy [14]. JIT also defined as a philosophy of manufacturing based on a management plan, the concept of delivering raw material [15] and producing products when needed as well as to emphasise continuous improvement [16]. Ashis [15] noted that consumers often pay a surcharge over the original quoted wholesale price while purchasing items in smaller quantities. Although the JIT

contribution generally to improve operational performance has been approved in, there are some of the researched studies about the JIT barriers.

2.0 METHODOLOGY

The research method is systematically planned for the clear research plan. Research has been started with problem identification, continuing with project design and planning and developed research objective and study plan. There are three objectives has been appointed for this study and four study plan method will be used to conduct this study. The research method describes that research collected primary data mainly through the in-depth interview with the internal XYZ manufacturing employees and suppliers. The study has also been conducted through observation checklist in the fieldwork such as looking into the information system, visiting the warehouse and observing the operational process of warehouse and production floor.

Researcher prepared the interview questions to understand the current supply chain practice and inventory management in this company in advance and emails to the interviewee for their review and preparation before interviewing. The semi-structured approach used to the entire interviews that were conducted and also raised unprepared questions of relevance when interacting with the interviewees during the conversations. A semi-structured interview was applied to the later stage of data collection action, to keep a focus on identified questions and digging deeper into the questions. However, the flexibility during the interview been allowed to a certain degree. Open coding, systematic coding and diagramming analysing data for the interview instrument been employed to analyse the interview data. There are five data collected from interviews and data will be analysed based on the interview outcome from interview questions. Data has been analysing based on similarity or relationship answer from an interview with one another review. The finding will determine the overall supply chain process in this company and if there is a possibility to implement VMI or JIT or both methods in XYZ manufacturing in order to improve their inventory problem.

The researcher also gathers the inventory data of company as secondary data of document review method. The data was retrieved from the Microsoft Dynamic Navision which is ERP system in that is using in this company. Annual usage, cumulative usage in value (RM) and percentage and also cumulative of the items will be calculated to determine the category for each 307 items in Microsoft Dynamics Navision system. All data evaluation will be a benchmark to the supplier as a data sharing in order to implement the VMI or JIT.

Concurrently, data from interviews and observation checklist will be analysed to propose a guideline to the organization of those inventory controls, VMI and JIT could be implemented in this organisation. The report prepared to explain the whole study process before we can conclude this research is completed. All the primary and secondary data collection in the company was under the permission of the manager and without offence in ethical rules through the whole research process. Therefore, to answer objective number three, data will be collected based on interviewing locally. This qualitative data will be analysed using open coding, systematic coding and diagram. The researcher will also analyse the similarity or

any relationship answer between each interviewee or with any similarity with literature review from previous researchers.

Samples of four persons from XYZ manufacturing top management and executive level have been appointed to conduct the internal interview. They are the production engineer, purchaser executive and logistic executive. The criteria for the selection are based on their job scope and responsibility as a decision maker, company profit, and production process and purchase the parts and supply chain process in this organisation. The local supplier will be chosen base on ABC category that highly considers the item in A and B category due to the high value and demand of A and B category. We also analyse the potential supplier capability to implement the VMI and JIT method. There a total of 125 local vendors and a part of those 8 vendors located in around Klang valley were identified as a sample. Subsequently, vendors were filtered based on location in Klang Valley and the nearest area to XYZ manufacturing such as Shah Alam, Klang and Subang Jaya. Notify email will be sent to them to arrange a meeting interview at their place and at the same time, we will look around to do observation at their place.

3.0 RESULTS AND DISCUSSION

XYZ Group is a world leading company in the kitchen hood manufacturing industry, which based in Finland headquarters. They are an establishing company from operating in 52 countries and running ten manufacturing factories around the globe. There are three business segments under XYZ group which are provider indoor climate solutions for public and commercial building, food service for commercial kitchen and restaurant as well as marine. The company as a food service provider offers a broad range of hi-tech technology and quality of kitchen hood for hotels restaurant, hospital or cafeteria kitchen. To date, the company was established for 20 years in Malaysia with 94 current employees in total with an annual turnover of approximately 55 million ringgit. Rapidly development of R&D and producing more product variety in Malaysia factory, now the item in inventory is enormous and reaching approximately 350 items compared only 209 items on last three years. The local suppliers, there are currently having 125 suppliers from Penang, Klang Valley, Kedah and Negeri Sembilan. The shipment commonly using by lorry or truck and the ETA is three to 14 days based on the supply item. However, the purchasing method is based on the requirement from store keeper and has no guidelines for the correct time and quantity to replenish the item. Therefore, the company still having run out of stock which interrupts the production process and company have to bear the back order cost.

3.1 Supply Chain Process Flow

In order to achieve research question number one, the researcher was studying the current supply chain and inventory management between XYZ manufacturing and their suppliers. There are almost 165 active suppliers included local and oversea making business with XYZ manufacturing A part of that, 125 are local suppliers and the rest from all over the world included the United Kingdom (UK), Slovenia, United States (USA), France, Finland, Germany, China and Hong Kong. The main parts to produce the product are supplied by the local supplier which is in Penang,

Johor, Negeri Sembilan, Kedah and Klang Valley. Even though these local suppliers' locations are just nearby, but they still are frequently facing the shortage of parts.

There are a variety of tools for synchronizing the supply chain and the most popular strategy in the manufacturing industry is Vendor-Managed Inventory (VMI) practice. However, XYZ manufacturing has never been implementing such practice to manage their inventory. Therefore, we will study the current supply chain practice in this organization and the possibility to implement this practice in XYZ manufacturing Sdn. Bhd to improve their inventory management and also production performance.

3.2 Inventory Demand Data

To achieve research question number two, data have been analyzing and found that all suppliers are using the ERP system such as SQL, Autocount, SAP and Microsoft Dynamics Navision. 50% of the supplier are using the SQL, 23% use Autocount, 13% use SAP and 12% use Microsoft Dynamics Navision. Furthermore, 63% of the suppliers haven't accessed the customer of supplier inventory database via online. However, 25% of the suppliers have experienced accessing and managing customer inventory database. In the other hand, 12% of suppliers can manage their supplier inventory database because of their sister company in oversea. Therefore, we can conclude that 37% of XYZ manufacturing's suppliers have experienced managing third party inventory via the online database.

3.3 Possibility to Implement VMI or JIT

Data collected from interviewing method with 8 suppliers found that 50% of the suppliers think that they can cooperate with Vendor-managed Inventory (VMI) method, 37% said Just- in Time (JIT) method is possible to implement with XYZ manufacturing and 13% said neither VMI nor JIT methods they can commit. The benefit of implemented the both methods is the better control for both sides. Suppliers will have sales security if they implementing the methods with their customers. Additionally, customer and suppliers can reduce their inventory cost and gain better inventory control. In term of cost, most of the suppliers state that unstable Ringgit Malaysia exchange rate is giving implication into their business.

Some of the suppliers are purchasing the parts based on the current exchange rate, therefore they can control their purchase price in minimum level especially in USD currency. By implementation of the VMI and JIT, suppliers may increase their selling price to cover their transportation cost such as another 5% from current price. However, it would also depend on an agreement with the customer to review the price. The barrier to implement the VMI or JIT methods has been identified such forecast given by customer may not be accurate or totally out of the plan. In the other hand, confidentially issue such as data sharing by the customer might be one of the barriers implementing these methods. Another challenge is to educate the supplier to follow the rules of the methods such delivery date, replenishment or supplier visit time and packaging method in order to get a successful method.

4.0 CONCLUSION

In this part of the empirical study, the researcher is going to propose to XYZ Manufacturing, whether Vendor Manage Inventory (VMI) or Just in Time (JIT) or both methods can be implemented in this organization in order to improve inventory management. Based on data collection, the researcher found out that, both VMI and JIT could be implementing in this company. However, there are limiting to local suppliers only. The barriers implementing the VMI and JIT have been highlighted by the supplier throughout interviews session. Therefore, three recommendations which are auto generate Purchase Order, customer and vendor portal and barcode system identified to encounter the barrier.

4.1 Auto-generate Purchase Order (PO)

To improve the purchaser job more efficiently and encounter the problem found in objective one, XYZ manufacturing can customize the current ERP system (Microsoft Dynamics Navision) with auto generate Purchase Order (PO) by triggering the data of inventory control which has been set up in each item in the inventory list. The process will start with generating the sales order, inventory capturing inventory quantity in the production order by Bill of material (BOM), the system will trigger the item which reached the inventory reordering point and auto generates PO will pop-out to notify the replenishment quantity for those particular items. Therefore, the end user will click button OK proceed to generate the PO and verify the quantity. Finally, PO generated and will send directly to the suppliers via email or fax number. The researcher found the estimate to implement this auto PO generating is approximately MYR35,000. It such a good investment for a long time and also can reduce human mistake if technology can take over it.

4.2 Customer and Vendor Portal

An extranet is a website that allows controlled access to partners, vendors and suppliers or an authorized set of customers, normally to a subset of the information accessible from an organization's intranet. An extranet is similar to a DMZ in that it provides access to needed services for authorized parties, without granting access to an organization's entire network. An extranet is a private network organization. XYZ manufacturing can purchase an online database, which allows the supplier to review the safety stock, minimum and maximum stock and reordering point data. By sharing the information in extranet, XYZ manufacturing can keep their confidential data safety compared to if sharing the whole Microsoft Dynamics Navision database with the supplier.

4.3 Barcode

Inventory management systems that use barcode technology increase the accuracy and efficiency of managing inventories. All major retailers use barcode technology as part of an overall inventory management program. When the barcode gets read at the point-of-sale (the computerized cash register), inventory sales data are immediately read to a broader system that maintains usage statistics. The company's purchasing department uses these data to make buying decisions based on sales and existing inventory levels. Barcodes also manage inventory at the warehouse level.

Most warehouses use the barcode or radio frequency identification (RFID) to scan incoming inventory into the warehouse's inventory management or warehouse management software. Barcode technology facilitates the movement of inventory within the confines of the warehouse (from one location to another) or from the supplier to the warehouse (receiving) and from the warehouse to the customer (picking, packing and shipping). Before implementing the barcode system, the significant aspect is to get the barcode identification from over the member organization in countries all over the world.

This research contributes the three ways and practices in the three ways. The researcher provides the empirical evidence on the current supply chain and inventory control practice between XYZ manufacturing and their suppliers. The sophisticated study on data of inventory control has not been analyzed previously in XYZ manufacturing. The inventory control data contribute a proper and clear figure for proper planning and could focus on the items in which in A or B category. This study contributed an empirical evidence to recommend that the VMI and JIT can be implemented in this company based on the outcome by the supplier.

Limitation and future developments of this study should be considerate along with the result. This research has three limitations. First, interviewees only have one time to response within a particular time frame. They probably cannot response truthfully and share more input in the interview session. Second, due to the economic recession the sample was relatively small; only 8 local suppliers. The local supplier only selection in Klang Valley area, although there is main supply located in Penang. Thus, the number of samples should increase in order to acquire more accurate data. Third, the research only conducted in one specific kitchen hood manufacturer.

Future research in a similar study should be conducted in other organizations in the same industry and in the countries, in order to establish whether these findings are valid for those organizations. Another research instrument can be employed in further research such as document analysis. Further opportunities for delving more deeply into the effectiveness of implemented these two systems in XYZ manufacturing. The result can be a benchmark to other sister company, to implement the same kind of inventory system.

REFERENCES

[1] Atul B. Borade, S. V. B. "Study of vendor-managed inventory practices in Indian industries." Journal of Manufacturing Technology Management, No. 21(8). (2010) 1013-1038.

[2] Matsebatlela & Mpofu M.G "Inventory management framework to minimize supply and demand mismatch on manufacturing organization. IFAC-PaperOnline, No.48(3). (2015). 260-265.

[3] Kefie Li and Jianling Jiau. "Analysis of inventory management in China Enterprise". Contemporary Logistics. No.6 (2012).

[4] Raphella, D. A., Nathan, M. G., & Chitra. "Inventory Management- A Case Study." International Journal of Emerging Research in Management &Technology, No.3(3). (2014).

[5] B.Rostami, T., & E. Sahin. "The Impact of Advance Demand Information On The Performance Of Production/Inventory Systems." International Federation of Automatic Control (IFAC), No.48-3.(2015). 1744-1749.
[6] Raphella, D. A., Nathan, M. G., & Chitra. "Inventory Management- A Case Study." International Journal of Emerging Research in Management &Technology, No.3(3). (2014).
[7] Mateen, A. C and Ashis Kumar. "Vendor managed inventory for single-vendor multi-retailer supply chains." Decision Support Systems, 70, 31-4 (2015).
[8] Rahim, Mohd, K. I., and Abdul Aghezzaf El-Houssaine. "Implementing a Vendor Managed Inventory Policy in a Two-Stage Supply Chain with Stochastic Demands." IFAC Proceedings Volumes, 45(6), (2012) 602-607.
[9] Hariga, Gumus, Daghfous, A. S. K., and Goyal. "A vendor managed inventory model under contractual storage agreement." Computers & Operations Research, 40(8), (2013). 2138-2144.
[10] Franke, P. D. "Vendor-managed Inventory for High Value Parts: Results from a Survey Among Leading International Manufacturing Firms." Univ.-Verlag der TU. (2010).
[11] Rao, A. M. K. P. "Development of a Spreadsheet Based Vendor Managed Inventory Model for a Single Echelon Supply Chain: A Case Study." Serbian Journal of Management, No.5(2), (2010). 199-211.
[12] Chopra, S., & Meindl, P. "Supply Chain Management: Strategy, Planning, and Operation." Global Edition:Pearson Education Limited. (2015).
[13] Amasaka, K. "New JIT, New Management Technology Principle: Surpassing JIT." Procedia Technology, No.16. (2014). 1135-1145.
[14] Zhixiangn Chen, & Kim, H. T. "The Impact Of Organization Ownership Structure On JIT Implementation And Production Operations Performance." International Journal of Operations & Production Management, No.33(9) (2013). 1202-1229.
[15] Chakraborty, Abhishek, C., & K. Ashis. "A surcharge pricing scheme for supply chain coordination under JIT environment." European Journal of Operational Research, No.253(1), (2016). 14-24.
[16] Gurinder, S., & Ahuja, I. S. (An evaluation of just-in-time initiatives in the Indian industries. International Journal of Quality & Reliability Management, No.32(6), 2015). 559-588.

Critical Success Factors for Technical Expert Trainees Skills Development

Siti Aisyah Minhad [a] *and Saardin Abdul Aziz*[b]

UTM Razak School of Engineering and Advanced Technology, Universiti Teknologi Malaysia, Jalan Sultan Yahya Petra, 54100 Kuala Lumpur, Malaysia
[a]*aisyahminhad.251@gmail.com,* [b]*saa.kl@utm.my*

Abstract – *The skills development which aid in the transition from purely technical skills to the intangible task of management may have been neglected thus making employability even more difficult. Yet, technical expert trainees with very technical achievements which lead to aviation career success but it often lead to the success of positions influence community or organization where the are critical factor to success. The main objectives of this study are to identify the set of skills development that important to the technical expert trainees, to investigate the effectiveness of skills development for technical expert trainees and finally to proposed a framework to improved skills development. This study used Factor Analysis, Importance Performance Analysis (IPA) and Quality Function Deployment (QFD) to achieve the objectives. The finding from factor analysis is the attributes of problem solving and analytical skills as the most important skills development to technical expert trainees. Meanwhile, analysis from IPA indicated that practical application and communication skills are the most effective attributes. QFD revealed that problem solving and analytical skills are the attributes that require improvement to ensure the critical success factor for skills development to technical expert trainees.*

Keywords: Skills Development, Critical Success, Factor Analysis, Importance Performance Analysis, Quality Function Deployment (QFD)

1.0 INTRODUCTION

Aviation education training has generated tremendous excitement both inside and outside higher education. Aviation is also a field of intensive technical training limited emphasis on development of soft skills which frequently needed in dealing with complexity of organizational leadership [1]. For some, it offers the potential to provide learning to new technical expert trainees; for others, it offers the opportunity fundamentally to transform technical knowledge learning delivery and the soft skills development. Aviation has historically been a field of intensive technical training with limited emphasis on development of soft or human skills so frequently needed in dealing with the complexities of organizational leadership. In the area of aviation, the need to have higher technical knowledge is undeniable but the importance of competencies such as practical application skills, problem solving skills, analytical skills and communication skills development should be given priority in order to avoid human error because it's involve a matter of life and death.

While in process of delivering a program there is a gap between technical knowledge and skills development to trainees. In conjunction with this, technical expert trainees facing difficulty while performing their task in industry placement because of the lack

of skills development elements although the trainees are fully equipped with the technical knowledge. Human capital that has been equipped with development skills as communication skills, ability to work in teams, ability to think creatively and ability to make decision and has good skills development and excellent in technical knowledge will be more competitive in the industry. The elements of skills developments i.e. practical application skills, problem solving skills, analytical skills and communication skills are a critical success factors to ensure the acceptable of technical expert trainees in the industry.

2.0 METHODOLOGY

Data were collected through a survey to students enrolled in UniKL MIAT. The survey on the technical expert alumni involved 30 respondents of which from various aviation industry. Meanwhile, there were 170 respondents from technical expert trainees from UniKL MIATs' technical programme are involved in this survey. There were four sections in the questionnaire to be answered. The questionnaire used in this study refer to the questionnaire purposed by Nora and Noor [10] then by the researcher modified and adapted it in order to determine the feedback from technical expert trainees and technical expert alumni regarding their perception on skills development in UniKL MIAT.

3.0 RESULTS AND DISCUSSIONS

This study was conducted in all technical training programmes in UniKL MIAT. A total of 170 questionnaires were administered to the technical expert trainees and a total of 30 questionnaires were randomly sent to technical expert alumni. Out of these, all questionnaires were successfully collected, indicating a 100% response rate. In this research the pilot study was conducted with twelve technical expert trainees in various semester and program as a purpose to test either the questionnaire is easy to understand and answered. The feedback from pilot study is used to improve the instrument so it can reflect the research objective and the research question. Coding was given to the reason to the concept test questions.

Reliability test was conducted for each of the questionnaire for technical expert trainees and technical expert alumni. Each section in the questionnaire has been analyzed to measure the reliability of the scale. All section has shown ideal Cronbach alpha coefficient of a scale are more than 0.7. All section has found to have a good internal consistency with Cronbach alpha coefficient reported of 0.85. Meanwhile, the reliability statistics of technical expert alumni and the in the current study the Cronbach alpha coefficient was more than 0.85. Interestingly, the reliability sore for both technical expert trainees and technical expert alumni observed to have a scale which found reliable with good internal consistency.

3.1 The important set of skills development

The researcher has conducted extensive literature review to identify skills development for technical expert trainees. Therefore 20 attributes of skills development were discovered, which are grouped into four dimension or variables namely practical application skills, problem solving skills, analytical skills and communication skills. Factor analysis was conducted to identify the underlying

factors in skills development to the technical expert trainees. The approach use is exploratory factor analysis in early stage of research to gather information about the relationships among a set of variables. The factors were extracted with a principal component analysis and four factors emerged from the factor analysis. Each factor displays high level of reliability with Cronbach alpha >0.7. An examination of the Kaiser-Meyer Olkin measure of sampling adequacy suggested that the sample was factorable (KMO=.918).The result of the factor analysis are summarize in Table 1.

Table 1: Kaiser-Mayer-Olkin and Bartlett's Test of Sphericity

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.918
Bartlett's Test of Sphericity	Approx. Chi-Square	1697.495
	df	190
	Sig.	.000

3.2 The effectiveness of skills development for technical expert trainees

In this study, the Importance Performance Analysis (IPA) is used to assess technical expert trainees and technical expert alumni's perception toward critical success factors on skills development. Our adaption of the IPA approach is used as a method to defined the effectiveness of skills development by translating each quadrant as area of concern, system strength, low priority and excessive. By measuring the technical expert trainees and technical expert alumni's reaction to programme, it can be interpreting the data to measure effectiveness of skills development.

The data appear in Quadrant I is an area of concern which require treatment to be prioritized by the management level in UniKL MIAT for improvement, since the rate of interest are high and low performance satisfaction rated by technical expert trainees and alumni. The variables in Quadrant I have indicated the attributes of problem solving skills and communication skills are less effective for the skills development of technical expert trainees. This is because Quadrant I indicates a main priority area need to be considered in measuring the effectiveness of skills development to technical expert trainees. The variables are implementing effective solutions, helped make progress in my acquisition of the language and developed presentation skills.

The Quadrant II showed the area to be preserved, because the high level of interest while performance satisfaction levels are also high level of interest while performance satisfaction levels are also high. Quadrant II the data yielded by IPA matrix can be interpret as system strength of the effectiveness to skills development of technical expert trainees. The variables in Quadrant II are effective in enhancing my understanding on tools and technique that can be used to perform task, provide opportunities to present and perform a practical task, effective in developing independent thinking, developed my ability to interact with a diverse group of people, improve oral communication and encourage speaking clearly. All variables are from practical application skill, problem solving skills and communication skill as shown in Table 2.

Table 2: Importance Performance Analysis for Technical Expert Trainees and Alumni

Categories / Attributes / Variable	Trainees		Alumni	
	Mean	Standard Deviation	Mean	Standard Deviation
Practical Application Skills.				
1. Ability to apply theory to practice.	3.729	.7519	3.933	1.0483
2. Provide opportunity to practice the skills required in the industry	3.706	.8188	3.900	.9595
3. Synthesize technical knowledge and practical application skills.	3.682	.7169	3.933	1.0148
4. Effective in enhancing my understanding on tools and technique that can be used to perform a task.	3.929	.8397	4.033	.9994
5. Provide opportunities to present and perform a practical task.	3.800	.8184	4.033	.8899
Problem Solving Skills.				
6. Developed my ability to provide constructive critiques to others.	3.459	.8504	3.967	.8899
7. Implement effective solution.	3.618	.8073	4.033	.8087
8. Effective in developing independent thinking.	3.724	.7769	4.067	.8277
9. Encouraging to formulate the problem and proposing solution.	3.659	.8221	3.967	.8503
10. Develop critical thinking and analysis of argument to solve the problem.	3.588	.9009	3.800	.8469
Analytical Skills.				
11. Developed ability to read and think critically.	3.765	.7942	4.000	.9097
12. Conceptualize and present an idea in technical medium.	3.553	.7921	3.933	.8683
13. To apply analytical skills.	3.600	.7950	3.933	.9072
14. Effective in developing planning abilities	3.647	.7647	3.867	.8193
15. Encourage to use information read or heard to perform effective skills.	3.853	.6764	3.967	.9279
Communication Skills.				
16. Developed my ability to interact with diverse group of people.	3.818	.8404	4.333	.7581
17. Improve oral communication.	3.700	.9027	4.300	.7944
18. Helped make progress in my acquisition of the language.	3.659	.8504	4.167	.9129
19. Developed presentation skills.	3.659	.9043	4.200	.7611
20. Encourage to speak clearly.	3.782	.8389	4.033	.9279

Meanwhile, Quadrant III provides an indication of low priority areas because the low level of interest while performance satisfaction levels are also low. In this quadrant, there are several factors that are less important effect to technical expert trainee. Quadrant III indicates the variables in this quadrant are less effective toward technical expert trainee. The attributes involve are from practical application skills, problem solving skills and analytical skills. The variables appears in Quadrant III are Synthesis technical knowledge and practical application skills, developed my ability to provide constructive critique to others, encouraging to formulate the problem and proposing solution, develop critical thinking and analysis of argument to solve the problem, conceptualize and present an idea in technical medium, to apply analytical skills and effective in developing planning abilities as shown in Table 3.

Table 3: Importance Performance Analysis Matrix for Technical Expert Trainee

No	Variable	Quadrant I (Area of Concern)	Quadrant II (System Strength)	Quadrant III (Low Priority)	Quadrant IV (Excessive)
1	Practical Application Skills		▪ Effective in enhancing my understanding on tools and technique that can be used to perform a task. ▪ Provide opportunities to present and perform a practical task.	▪ Synthesize technical knowledge and practical application skills.	▪ Ability to apply theory to practice. ▪ Provide opportunity to practice the skills required in the industry
2	Problem Solving Skills	▪ Implement effective solution.	▪ Effective in developing independent thinking.	▪ Developed my ability to provide constructive critiques to others. ▪ Encouraging to formulate the problem and proposing solution. ▪ Develop critical thinking and analysis of argument to solve the problem.	
3	Analytical Skills			▪ Conceptualize and present an idea in technical medium. ▪ To apply analytical skills. ▪ Effective in developing planning abilities	▪ Developed ability to read and think critically. ▪ Encourage to use information read or heard to perform effective skills.
4	Communication Skills	▪ Helped make progress in my acquisition of the language. ▪ Developed presentation skills.	▪ Developed my ability to interact with diverse group of people. ▪ Improve oral communication. ▪ Encourage to speak clearly.		

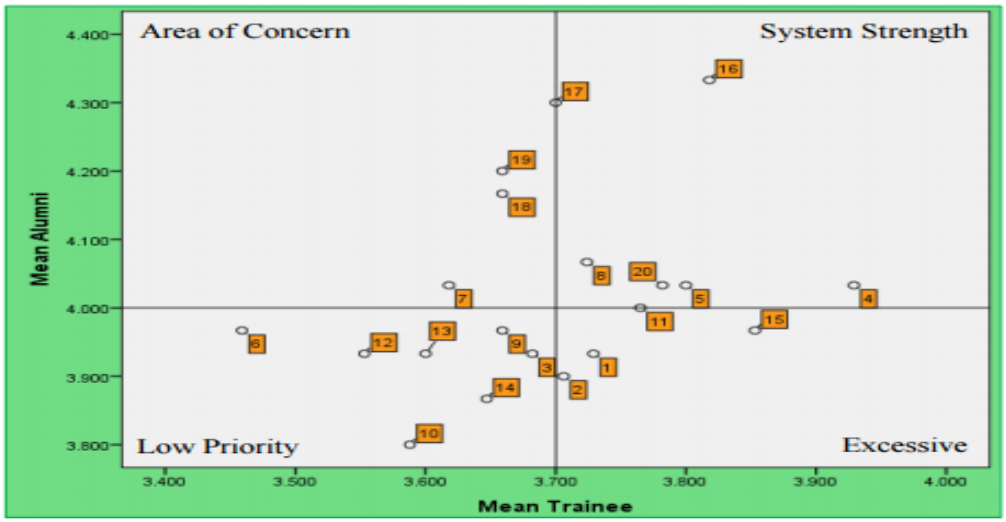


Figure 1: Importance Performance Analysis Map for Skills Development

3.3 Proposed Framework

The final result of this research is a recommendation of a framework to improve skills development implementation. The recommendation is obtained by using Quality Function Deployment (QFD). This research used three QFD matrixes, in order to get the optimum result. The first QFD matrix is developed to determine relationship between customers' needs which is referring to technical expert trainees with technical response that done by technical expert alumni to fulfill the customer needs. To respond to the customer needs, then performed the preparation of planning matrix, technical requirements or technical response, relationship matrix between customer needs with technical response, technical correlation, and technical matrix as shown in Figure 2.

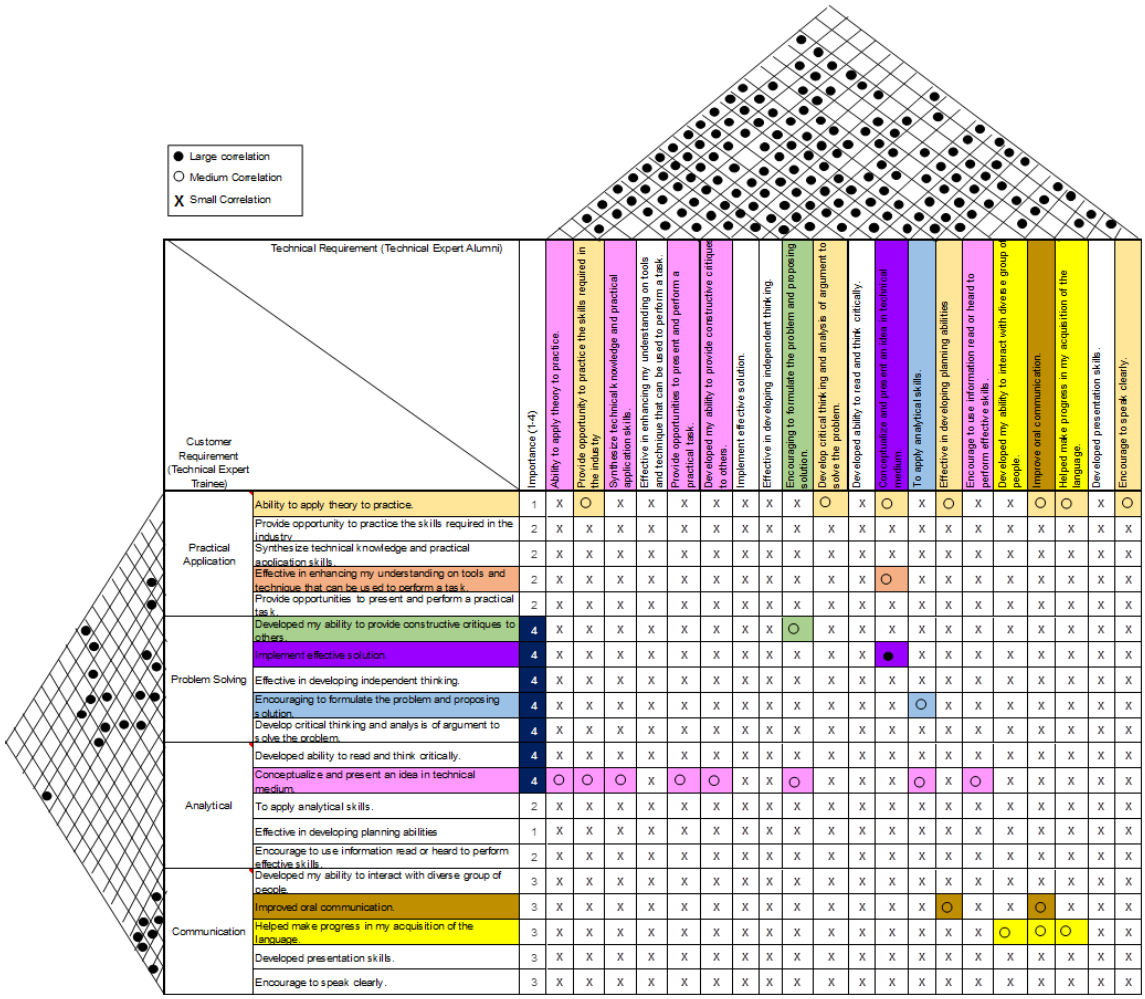


Figure 2: Quality Function Deployment

Figure 2 illustrates one of the main characteristics of the inter-correlations among technical expert trainee and technical expert alumni. Referring to the strong and medium correlation, QFD has summarized a few variables that are required improvement on skills development for technical expert trainees. As can be seen from the data in Figure 2 revealed of eight variables that have been observed to have similar correlation which consists of ability to apply theory to practice, effective in enhancing my understanding on tools and technique that can be used to perform a task, develop my ability to provide constructive critiques to others, implement effective solution, encouraging to formulate the problem and proposing solution, conceptualize and present an idea in technical medium, improved oral communication and helped make progress in my acquisition of the language. Based on QFD matrix summary in Table 3.5 provides a requirement on planning capability in enhancing skills development to technical expert trainees. Moreover QFD can present the element in skills development which are inconsistencies between requirements, risk and needs of the technical expert trainees to fully equip before enter aviation industry.

4.0 CONCLUSION

After discussing the findings of the research, certain recommendations are put forward for consideration. The research findings and interpretation reveal that measure need to be taken to ensure that the skills development to the technical expert trainees are success according to the current need of industry.

Based on the factor analysis, importance performance analysis and quality function deployment; the critical success factor for skills development is problem solving skills and followed by analytical skills and practical application skills. UniKL MIAT is suggested to conduct a training programme that can provide a learning environment for trainees to develop problem solving and critical thinking skills. Instructor are encourage to embedded in their training to teach problem solving skills by enhancing a decision making, transmission and self-governance and responsibility in the student. The instructor suggested promoting more activities on teaching and learning that can stimulate the skills of problem solving to technical expert trainees. According to Ahghar [13] problem solving skill training is effective in self-regulation learning of students and has good stability over time.

UniKL MIAT need to work closely with industries to improve skills development for technical expert trainees since the employability of the trainees is one of the key performance indicators for training instituition. In addition, the training programme can develop a task that are assigned should be beneficial in enhancing skills development. The skills development efforts of technical expert trainees should be further enhanced through the integration of generic skills development modules (stand-alone) into the training programme that would prepare trainees for employment. Referring to study by Panagiotakopolus [14], a “career development” module, could give students the opportunity to study the current employment situation and to develop a personal action plan for subsequent employment. Mohamad Shukri Abdul Hamid, Islam, and Manaf [5] suggested that work integrated learning is a form of training whereby periods of study are alternated with periods of related work in an organisation. UniKL MIAT is recommended to conduct work integrated learning which technical expert trainees are able to practice the theorical and knowledge that they have learned, to develop their analytical thinking and problem solving skills and to enhanced the communication skills.

REFERENCES

[1] Baker, G., & Henson, D. Promoting employability skills development in a research-intensive university. Education + Training, 52(1), 62-75. 2010.
[2] Chapman, D. J. a. E. Non-technical Skills Gap in Australian Business Graduates. Journal Education + Training, 54(2/3), 95 - 113. 2012.
[3] Hebbar, D. N. A. J. a. D. C. K. Use of Quality Function Deployment Analysis in Curriculum Development of Engineering Education and Models for Curriculum Design and Delivery. Proceeding of the World Congress on Engineering and Computer Science. 1 - 4. 2008.
[4] Lord, T. V. D. Critical Success Factors in Online Education. International Journal of Education Management, 14(5), 216 – 223. 2000.

[5] Mohamad Shukri Abdul Hamid, R. I. a. N. H. A. M. Enhancing Malaysian Graduate Employability Skills: Quality Function Deployment Approach. Proceeding of the International Symposium on the Analytic Hierarchy Process, 1 -14. 2013.

[6] Roji, N. M. a. N. S. M. A Quality Function Deployment (QFD) Approach in Determining the Employers' Selection Criteria. Journal of Industrial Engineering, 1 - 10. 2015

[7] Saunders, I. K. L., & G.Saunders, J. House of Quality Assessment of Business Skills Required by Manufacturing Engineering Graduates. *Int. J. Engng Ed., 20*(5), 777-786. 2004.

[10] Nora M. & Noor S.M.R. A Quality Function Deployment (QFD) Approach in Determining the Employer's Selection Criteria. Journal of Industrial Engineering. 2015.

[11] Fatima J. H & Paula O.F Importance Performance Analysis as a Tool in Evaluating Higher Education Service Quality: The Empirical Result of Estig (IPB). 2015.

[12] Dene H, Zulfa F.I & Euis N.S.Y. Improving the Service Quality by Using Importance Performance Analysis and House of Quality in SMK Pls Laboratorium Indonesia, Karawang. International Journal of Engineering and Applied Sciences. Vol.2, No.3. 2013

[13] Ahghar, G. (2012). Auto-regulation learning of High School Students in Tehran. Procedia - Social and Behavioral Sciences, 69, 688 - 694.

[14] Panagiotakopolus, A. (2012). Employablity Skills Development in Greek Higher Education Institutitions (HEI). Higher Education, Skills and Work Based Learning, 2(2), 141 - 150.

Risk Management in a Large Scale Project of Manufacturing Industry

Kanesan Arrenvalagan[a] and Zainai Mohamed[b]

UTM Razak School of Engineering and Advanced Technology, Universiti Teknologi Malaysia, Jalan Sultan Yahya Petra, 54100 Kuala Lumpur, Malaysia
[a]arren.kanesan@gmail.com, [b]zainai.kl@utm.my

Abstract – *Projects that are complex and dynamic are subjected to high uncertainty and risk. Manufacturing and Engineering projects that constitutes on large industry projects are given attention are vulnerable to various technical, socio-political and business risks. Risks are well-known for a threat towards a project. Thus, risks emerged in a project are capable of rendering the objectives of the project which may be the reason contributing to project failure. As a result, the people working in the industry bear various failures, such as, failure of abiding by quality and operational requirements, cost overruns and uncertain delays in project completion. In light of this, it can be said that an effective systems of risk management for manufacturing engineering industry remains a challenging task for the industry practitioners. Hence, effective risk management is an essential skill that is required among practitioner in project handling in the industry to manage risks associated with the project. The aim of this research based project is to explore the typical project risks associated with construction industry and the application of the knowledge to produce project success in engineering manufacturing projects. In this research study, risk management and its elements are critically discussed along with the introduction of risk management practices framework. It is believed that the outcome of the study to guide the practitioners to lead the realization in terms of stakeholder's satisfaction, end user adaptation and quality of deliverables.*

Keywords: Risk Management, Risk Assessment, Manufacturing, Project Success

1.0 INTRODUCTION

Project and risk are inseparable. Engineering construction and manufacturing industry are two that are prone to much bigger risks. This is due to the fact they are highly complex and continuously exposed to various internal and also external risk. Risks are often referred to as threat towards a project. Thus, risk evolved in a project during the execution are can be an obstacle to achieve the objectives of the project which may be in turn be the reason contributing to project failure. Manufacturing of electrical equipment is highly complex and is continuously exposed to a variety of risks from internal and external and if the risks are not carefully managed, the result can be adverse impacts to sales and brand reputations of the deliverables.

1.1 Statement of Problem

Lately, it was observed that there are many project related issues arises during the project execution in the line of production. The issues arise have caused several impacts on the costings where the initial budgeted cost are burst, the schedule are not followed and causing delayed delivery of the project outcome. Besides that, the quality of the deliverable is also significantly affected and causing dissatisfaction among the stakeholders especially the customer and end user. This could potentially give a bad reputation to the brand image and organization corporate image in the industry. As such, effective risk management if an essential skill that should be equipped among the practitioner in the industry, particularly engineering construction and manufacturing industry for the purpose of managing risks throughout the evolution of risk during project management.

In this regard, the study on the scope of improving risk management practices is important as it provides a theoretical as well as a practical platform for the organization to gain sustainable competitive advantage. In order to provide the organization with a better perspective of managing risk, this paper aims to propose the best practices of risk management that can be implemented in the organizations within the Malaysian manufacturing industry context and remain competitive in the industry. This study differs from existing studies because it focuses on the understanding of risk and risk management, current risk management practices and then proposal of a framework to improve the current risk management in order achieve project success in the aspect of cost, time and quality.

1.2 Research Objectives

The goal of this research based project is to explore the risk culture and use of risk management to deliver a successful project with respect to cost, time and quality in manufacturing projects. Further to that, in this research study risk management and its elements are critically discussed along with the several literature reviewed across various industries and adaptation of risk management process into manufacturing projects as the key in delivering project success with the aim of reducing risk and deliver successful project. The research objectives (RO) can be detailed as follows:

RO 1: To identify how risks and risk managements are perceived in the firm.

RO 2: To identify risks and current risk management practices during project life cycle.

RO 3: To recommend the best Risk Management practices that improves project success with minimal risks during project execution in the organisation.

2.0 METHODOLOGY

2.1 Research Approach

For the purpose of this research, mixed-mode research approach has been utilized. Mixed-mode research is a combination of both qualitative and quantitative methods.

This is due to the matter of trying to reduce the weaknesses and the problems linked to mono methods, to ameliorate the validity and reliability of the results. Interviews are carried out to provide a description on the understanding of risk and how the samples experience the application of Risk Management in the complex project organization. The outcome of the qualitative risk analysis will unfold the potential critical risks list that impact most on the project success with respect to cots, time and quality.

2.2 Sampling

Face-to-face interviews were successfully conducted with 11 respondents, seven were conducted at the interviewee's office during office hours; two were during after office hours and 1 interview was conducted at the food court within the organization during break, as the interviewee were on tight schedule and not really available for the interview session. Each interview took approximately 40 minutes and the interviews were held in English in order to obtain as much information as possible to avoid any misinterpretation that could occur if the interview been held in other languages.

Questionnaires were distributed to all the interviewees to identify the impact of risk on cost, time and quality. Total of 25 random samples consists of interview participants and selected active project engineers were selected. Respondents were requested to participate in advance and provide information regarding the questionnaire were clarified, how the information will be useful for the research and terms of confidentiality were informed at the beginning stage. The respondents were given sufficient time of five days to complete the questionnaires. The response rate of the questionnaire was 100% as all the distributed questionnaire samples were returned.

2.3 Method of Probability and Impact in Risk Management

The risk matrix technique is one of the most used qualitative methods and is often used in organisations which exclusively perform a risk analysis based on the potential risks [6]. A risk matrix analysis is often the initial step to a more comprehensive risk analysis and used as a basis for a quantitative risk analysis.

Based on the input from the questionnaire, the scale of rate for occurrence of the risk and will be multiplied together with the rate of impact in order to get result. A questionnaire will be distributed to the respondents as for follow up for the interviews. The main objective of the questionnaire is to focus on the identified risks associated with manufacturing industry, and to arrange the risks in the probability and impact matrix. This chart will be used introduce the Risk Management Process method. In the questionnaire, the respondents were asked to evaluate the risks and its impact based on cost, time and quality of the deliverables. The scales used are as below and as adapted from Impact and Probability matrix from PMI.

3.0 RESULTS AND DISCUSSION

3.1 To identify how risks and risk managements are perceived in the firm.

Based on the interview outcome, it can be concluded the Project Managers are aware and familiar of the Risk Management Practices, however, they tend to not to follow it in their everyday work situations. They tend to refer it as a process of managing risk and it can be assumed that they are using Risk Management but they are not really aware of it. Besides that, there was one Project Manager was really very well versed in Risk Management process as close to the defined process in literature review. This is due to the fact from his past experience from one of his recent previous project that he handled, where risk management is one of the key elements to be reported to his client on weekly reporting on project progress.

For the first step in Risk Management Process, most of the interviewees are based on the past experience mentioned the possible way to identify risks was from the consequences already in early stages of the project. One of the respondent wanted to overcome the problems before it impacts on delivery schedule of production and it was important to deal with problems before the impacts or too late to avoid it. From the interview as well, it can be concluded that each Project Manager uses their own techniques to identify risk in their projects. Second step in Risk Management Process, is risk assessment. From the interview, it is known that discussion was the most widely used tool to manage and analyse the associated potential risks in the project. When question on how is current practice of dealing is performed, they have responded that, it is handled in an unstructured way. Again, it clearly shows that, they do not have any procedures to follow on minimize the risks.

From the interview, the respondents share different opinion on how they handle risks in their project although it can be summarized they do not have standard procedure, but they have their own ways on working with risks. It is the responsibility of the members involved in the project to manage their own identified risk pre, during and post production. When asked on the possibility of executing and delivering a zero error or zero risks project, almost all the respondents believed that delivering such a project was not really possible.

3.2 To identify risks and current risk management practices during project life cycle.

Table 1 below identifies the risks evolved during the multi-stages of production and the responses types that are taken to overcome it at present.

Table1 : Identified Risks and Response Types

		Type of Risks Identified	Response	
			Type	Description
Pre-Production	Tendering	Misquote / Inaccurate cost estimate	Mitigation	Detailed discussion with client and understand the requirement
		Misunderstand the client requirement	Mitigation	
	Establishing project objectives and draw up of project brief	lack of cooperation between actors in the project	Mitigation	Organize more meetings to find where is the problem in the team
		Shortage in resources	Mitigation	Expedite suppliers / alternative suppliers / from other projects
	Actual design/ Delay in drawing approval	Problems with design	Mitigation	Involve senior design engineers for verification
		Design not up to standards (non-conformance to codes and standards)	Transfer	Discuss with client to highlight the not up to standard requirements
		Changes in scope of work/Clients new requirement	Transfer	Transfer the consequences of risk to commissioning stage
		Delay from customer for approval	Mitigation	Pressure client to give approval on time
		Incomplete/inaccurate quantity estimates	Mitigation	Strategic Quantity Estimation Technique
		Gap of knowledge / Lack of experience of the design team	Mitigation	Detailed discussion with senior design team
	Material Purchasing	Procurement not ordering the right part	Avoid	Strategic Procurement / SCM
		Delay from suppliers	Avoid	
Production	Design error and/or omissions	Changes in scope of work/Clients new requirement	Transfer	Transfer the risk to production team where the delivery will be impacted
	Resource Management	Improper management of on-site manpower	Mitigation	Strategic manpower planning / utilization
		Non-skilled labor / Lack of coordination among design members' disciplines	Avoid	
	Safety	Accident / Near misses	Avoid	Strict safety rules / Proper PPE
	Manpower Error	Wrong wiring / termination	Mitigation	Frequent monitoring on the works carried out
		Wrong assembly	Mitigation	
		No supervision from Production Engineer	Mitigation	On site engineer during production
Post-Production	Final Inspection (Factory Acceptance Test)	Emphasis on meeting schedules & increased production volume (tight schedule)	Mitigation	
		Too many comments from Customer	Transfer	Client should have commented earlier, delay in delivery
		Reworks time	Mitigation	Delay in delivery
	Documentation and management	Lengthy project development period	Mitigation	Strategic Documentation

Probability and Impact method was chosen and performed to identify risks associated to project execution. This method has unfolded the risks with the biggest impact on

project cost, time and quality were identified. The results are tabulated in table below. In contrast, different results were obtained in research done by Ewelina [3], there are multiple risks that impact on cost, time and quality respectively as in Table 2 below.

Table 2 : Identified Risks associated with Cost, Time and Quality against previous research outcome

Impact	(Ewelina & Mikaela, 2011)	Current Research, 2016
Cost	• Miscalculation in the bidding process for the consultants • Not finding the right contractor	• Changes in scope of work/Clients new requirement • Problems from the design • Misquote / Inaccurate cost estimate
Time	• Moisture • Cheap solutions	• Changes in scope of work/Clients new requirement • Delays from suppliers, procurement not ordering correct parts • Non-skilled labour during production.
Quality	• Moisture • Not finding the right contractor	• Increased production volume • Problems with design • Gap of knowledge • Wrong assembly during production

3.3 To recommend the best Risk Management practices that improves project execution in the firm.

An effective, structured, proactive and enterprise-wide risk management framework doesn't just happen, the right foundations must be established and the many components must be aligned. The relationships between the various components of managing risks including the risk management framework is better highlighted and illustrated in ISO 31000 as shown in Figure 1 below [4].

Figure 1 : Risk management Framework

3.3.1 Establishing context

Establishing context is about setting the parameters or boundaries around the organisations risk appetite and risk management activities where the project manager needs to establish context of the risk management processes which includes amongst other things establishing a risk management policy, processes, methodologies, plans, risk rating criteria, training and reporting processes.

3.3.2 Risk assessment

This process comprises the process of identifying, analysing and evaluating risks. Risk analysis considers possible causes, sources, likelihood and consequences to establish the inherent risk. Existing management controls should be identified and effectiveness assessed to determine the level of residual risk. After this analysis, an evaluation of the level of risk is required to makes decisions about further risk treatment.

3.3.3 Risk treatment

Risk treatment is necessary, where the level of risk remains intolerable. Risk owners can treat risks by avoiding the risk, treating the risk sources, modifying likelihood, changing consequences or sharing elements of the risk. The remaining level of risk retained should be within risk appetite [5].

3.3.4 Monitoring and review

Planned, regular monitoring of the risks and the risk management framework including processes is critical to keeping the risk management framework relevant to the changing needs of the project and external influences. Monitoring and review will be undertaken by risk owners, for instance Project Managers in this study. An independent review of the risk management framework should be undertaken from time-to-time [7].

4.0 CONCLUSION

This research has successfully achieved all the research objectives. Thru the research, the knowledge about the risk and risk management were discovered. Further to that, critical risks associated during project execution being unfolded in this section thru Probability and Impact Matrix. Current practice of risk management is further explored and presented. Lastly, a framework consists of six steps adapted from ISO31000 has been adopted to be implemented in order to manage risk at the organization. Implementation of Risk Management Process would lead to project success by reducing project cost overrun, time delay and quality related issues.

4.1 Contributions

This research stresses that the implementation of its proposed framework should be encouraged to foster efficient risk management in project management practices through better informed decision-making as it can be tailored to fit the organization

environment. Additionally, the framework also believed to serve as a basis for establishing good governance and internal controls that will ensure risk is managed systematically. Successful implementation of effective risk management would assist project success thru reduced cost overrun, delayed delivery and ensure project deliverables is up to the customer expectations. This could be implied with term of project success thru stakeholder's satisfaction, end user adaptation, quality of deliverables and many others.

4.2 Limitations

This research provides a framework of Risk Management Process which can be adopted for the purpose of managing risk during project execution. The framework adopted has not been tested in the organization. It is highly recommended that future research to be conducted on the application of the risk management process framework formulated thru this research as best practice for the organisation in study. The scope of this study is within the production of switchgear only. Upon the successful application, this framework should then be extended and adopted into other department as well with the primary aim of ensuring successful project execution. It is also advised that each department to be treated and tested separately in order to compare the outcome from the application of the framework in practical. Another possible research in the future should be conducted to investigate and compare the Risk Management Processes between competitors as to learn the effectiveness of other adopted Risk Management Practices, including their lessons.

REFERENCES

[1] Baloi, D. (2012). Risk Analysis Techniques in Construction Engineering Projects. *Journal of Risk Analysis and Crisis Response* 2(2), 115.

[2] Barber, R. B. (2005). Understanding Internally Generated Risks in Projects. *International Journal of Project Management*, 23(8), 548-590.

[3] Ewelina, A., & Mikaela, R. (2011). *Risk Management Practices in a Construction Project – A Case Study*. Göteborg: CHALMERS UNIVERSITY OF TECHNOLOGY.

[4] Chapman, C. and Ward, S. (2011). How to manage project opportunity and risk-why uncertainty management can be a much better approach than risk management. New York: John Wiley & Sons Ltd.

[5] Chapman, C. and Ward, S. (1997). Project risk management: Process, techniques and insights. *The Journal of the Operational Paper Society* 49(7), 769-770.

[6] Flanagan, R., Jewell, C. and Johansson, J. (2007) Riskhantering i praktiken: Med exempel från byggverksamhet. Department of Structural Engineering, Chalmers University of Technology, Göteborg, Sweden

[7] Hillson, D. (2003). Effective opportunity management for projects: Exploiting positive risk. Florida: CRC Press.

Assessment of Quality Practices in Malaysia Oil and Gas Project Organization

Rabibah A Samawe [a], Sha'ri Mohd Yusof [b]

UTM Razak School of Engineering and Advanced Technology, Universiti Teknologi Malaysia, Jalan Sultan Yahya Petra, 54100 Kuala Lumpur, Malaysia
[a]rabibahas@gmail.com, [b]shari@utm.my

Abstract – *Total Quality Management (TQM) factors are essential in quality practices and have been implemented in most of the manufacturing and construction industry. In the recent trends, TQM gained attention in the project management due to its proven success in organizational improvement. Key factors such as leadership, employee empowerment, customer focus and continuous improvement play important practices in enhancing the project performance. Survey on TQM practices and project performance indicators were distributed to employee in one of oil and gas project organization in Malaysia. Descriptive and correlation analysis to 45 samples provides the indication of the level of quality practices implementation and improvement suggested to achieve success project performance. It is found that leadership plays the most important role in implementation of quality practices in the project organization. The success of employee empowerment, continuous improvement and customer focus factor is influenced by leadership strength. The level of quality practices in this organization is still moderate. Improvements were proposed based on the results analysed for the organization application.*

Keywords: Quality, Project Organization, Oil and Gas

1.0 INTRODUCTION

Total Quality Management (TQM) factors have been proven to be a good quality practices implemented in organizational improvement. There are many success story of TQM accomplishment in manufacturing and construction industry. The context of TQM is still not widely practiced in the Malaysia oil and gas organization due to its complexity and dynamic. It is observed in the past research that the concept of TQM is still new in most developing countries [1]. However, lack of implementation could be due to misconception of ISO 9000 standards principle and TQM philosophy as mentioned by Harrington, Voehl, and Wiggin [2] in their study. In a typical oil and gas project management, quality principle is based on ISO9001:2008 Quality Management system requirement and A Guide to the Project Management Body of Knowledge (PMBOK Guide).

Successful project performance required total enrollment of TQM important practices such as leadership, employee empowerment, customer focus and continuous improvement. From an observation in one of the Malaysian oil and gas organization, the implementation and importance of TQM is still lagging behind from the other industry. This study is intend to determine the level of current quality practices in the oil and gas engineering design organization using TQM practices identified from the literature. The importance of TQM practices will be measured to identify the key

factors that have strong relationship with the project performance. The findings will be utilized for application in the project organization.

Section 2 of this paper will elaborate the literature review conducted in TQM and project quality management. Sample collection and research method employed in this study will be explained in section 3 and the results are discussed in section 4. Finally, recommendation and conclusion of this study is deliberated in section 5 of this paper.

2.0 LITERATURE REVIEW

2.1 Quality in Project Organization

The performance of oil and gas project is bounded by the golden triangle comprising cost, time and quality. Comprehensive documentation process is normally practiced to track the project performance. Orwig and Brennan [3] and Cicmil [4] emphasize that the value of quality in project environment should not be limited to quality assurance. A total quality approach is new emerging agenda for project performance and success

2.2 Total Quality Management and Project Performance

Leadership, employee empowerment, customer focus and continuous improvement are the critical TQM practices selected are based on the research done in the area of quality practices in project management by several authors [2, 3, 5, 6, 7, 8, 9, 10, 11].

2.2.1 Leadership

Leadership involved top management support and senior management responsibility in the project life cycle. Active involvement of leadership and commitment for goal settings and vision in the organization is essential for TQM implementation and integration into the existing process [12]. The leadership need to fully understand the quality concept before cascading it down to their employee as it is an important factor in effective project management [2]. Basu [13] has included top management commitment in the organizational quality dimensions because of this element importance in setting up the organizational quality. Besides, management support and participation is important towards quality practice transformation [7, 9].

2.2.2 Employee Empowerment

Employee is the main driver in a project organization [10, 14]. In this emerging era, people is seeking a working environment that offers appreciation, involvement in decision making, trust and space for open communication [6]. Sharing the vision of the project encourage employee to work efficiently and adapted to process changes [15]. In a study done by Ugboro and Obeng [11], empowered employee gained job satisfaction in their work thus, it also translated into customer satisfaction.

2.2.3 Continuous Improvement

Continuous improvement means gradual and continuous process towards quality and efficiency. Learning is part of continuous improvement effort that must be emphasize

in the organization [14]. In a global competition, continuous improvement has become essential in achieving excellence quality through resistance of change and responding to customer needs, desires and taste [16]. PMI [17] encourage continuous process improvement activities as part of project quality management for better results. The concept of "plan-do-check-act" (PDCA) cycle is used in process improvement to reduce error in the result work and harmonized the effect before moving to new improving cycle [16].

2.2.4 Customer Focus

Customer can be defined as internal and external stakeholders involved in the process. External customer can be easily defines as the clients or the end user. However, organization always overlook internal customer as important factor in success of an organization [15]. In total, quality perception is not only limited to the end user but also need to be view from the shoes of the employee as internal customer. In the end, customer satisfaction will be depends on quality improvement and effectiveness of the "soft" TQM elements in the organizations [18]. Product quality is no longer a key element in project success factor rather than it should focused on less tangible products as customer is expecting top service, reliability, responsiveness, assurance and empathy [4].

3.0 RESEARCH METHODOLOGY

3.1 Sample Collection

Quantitative analysis has been done by conducting survey to the target population through survey. The questionnaires were developed based on Das, Paul and Swierczek [19] and Lau, Zhao and Xiao [20] construct and modified according to this study. The construct is divided into 3 sections. First section is to assess the demographic of the respondents to know the respondents age, position, years of experience and duration of involvement in the project. The next 16 questions were measured into two parts; first, to assess the current quality practices adopted in the organization. Then, respondents are required to indicate the importance of the practices towards project performance in their organization. Finally, respondents were asked to rate the degree of quality practices relationships with project performance based on cost, time and quality. The scoring was based on the 5 Likert scale points. A score of 5 reflects that the respondents strongly agree with the statement, meanwhile 1 strongly disagree.

Questionnaires were distributed using online survey platform to 100 respondents, which, among them are the executive officers, technical experts to senior level management. These are employees in engineering design phase project department in an oil and gas organization in Malaysia. The survey was carried out within two months. Follow-up with the respondents and face to face digital survey using tablet were performed to encourage responds. 46% responds rate was received and acceptable for the author to proceed with the analysis using SPSS V.22 statistical package.

3.2 Methodology

The questionnaires internal consistency was performed through a pilot survey before further analysis. Cronbach's alpha (α) coefficient was used to assess the reliability of the construct. It provides indication of average correlation of all the items from 0 to 1. Higher values show greater reliability. Nunnally [21] recommended 0.7 and above is acceptable for the test. Reliability of each of the quality factor was assessed and summarize in the Table 1 below. All the constructs Cronbach's alpha (α) range from 0.764 to 0.986 and acceptable for further survey.

Descriptive analysis was performed to analyse the mean of each of the scale. Correlation between the importance of the elements and project performance indicators were tested. Strong correlations between elements indicate strong dependency in the project performance success. Pearson correlation will be used to indicate the relationship. Correlation between the quality practices were also analysed to test the relationship among them.

3.3 Research Hypothesis

This study will assess the level of current quality practices and comparison made to the importance of the element. The comparison will indicate the level of improvement that has to be made in relationship to project performance indicator. Hypotheses were developed to understand the relationship between quality practices and the project performance.

H1: Leadership significantly contributed to project cost, time and quality performance

H2: Employee empowerment significantly contributed to project cost, time and quality performance

H3: Customer focus significantly contributed to project cost, time and quality performance

H4: Continuous improvement significantly contributed to project cost, time and quality performance

4.0 RESULTS AND ANALYSIS

46 responses received were analyzed for missing value. One response was excluded from the analyses due to missing information by author as suggested by Pallant [22]. Descriptive statistics was performed to analyze the respondent's profile. About 47% of the respondents are at the age of less than 30. This age might relate to the executive position in the organization. 47% of them have been working in the organization between 5 to 10 years thus; the feedback provided is credible for our analysis. The duration involvement in engineering design phase from 7 to 12 months, which is the ideal duration for a design phase, shows a score of 60%. Referring to Table 1, the quality practice implementation mean is low in the organization in comparison to the mean importance.

Table 1: Construct Reliability and Descriptive Analysis

Quality Practices	**Mean (μ)**	
Leadership (α= 0.833)	*Practice*	*Importance*
Our leadership team communicates the project vision and strategy to the employees	3.76	4.53
Our leadership team actively develops one integrated quality plan towards project objectives	3.69	4.47
Our leadership team strongly encourages employee involvement in quality management and improvement activities	3.76	4.31
Our leadership always emphasize on quality factor towards project success	3.69	4.44
Employee Empowerment (α= 0.764)		
Our organization has cross-functional teams or quality circles that encourage employee involvement	3.64	4.42
Employees are actively involved in quality-related activities	3.58	4.13
Employees' suggestions are evaluated and implemented in our organization	3.33	4.20
Employees are encouraged for suggestions and innovation in our organization	3.69	4.42
Customer Focus (α= 0.864)		
Our organization maintained relationship with our customer	4.00	4.38
Customer feedback is used as the basis of quality improvement	3.93	4.40
Our customer participate in our project activities	3.67	4.13
Our organization has a system to manage customer's feedback	3.67	4.27
Continuous Improvement (α= 0.832)		
Our leadership team emphasizes the continuous improvement of quality in all work processes at various levels	3.82	4.49
Feedback provided to employees on their quality performance	3.91	4.40
Assessment and improvement is done on processes, practices and services	3.80	4.33
Our company uses Plan Do Check Act (PDCA) cycle extensively for process control and improvement	3.49	4.16
Quality Practices Relationship with Project Performance	**Mean (μ)**	
Leadership and project performance (α= 0.849)		
Leadership factor contributed to project cost performance	4.44	
Leadership factor contributed to project time performance	4.51	
Leadership factor contributed to project quality performance	4.53	
Employee Empowerment and project performance (α= 0.938)		
Employee empowerment factor contributed to project cost performance	4.24	
Employee empowerment factor contributed to project time performance	4.47	
Employee empowerment factor contributed to project quality performance	4.49	
Customer Focus and project performance (α= 0.952)		
Customer focus factor contributed to project cost performance	3.93	
Customer focus factor contributed to project time performance	4.02	
Customer focus factor contributed to project quality performance	4.13	
Continuous Improvement and project performance (α= 0.986)		
Continuous improvement factor contributed to project cost performance	4.33	
Continuous improvement factor contributed to project time performance	4.33	
Continuous improvement factor contributed to project quality performance	4.44	

Correlation of important quality practices and project performance were investigated using Pearson correlation to identify the key element. All four quality practices together with its element are included as independent variables and to analyze the relationship with project performance indicator as the dependent variables. The summary is described in Table 2.

Table 2: Pearson Correlation Matrix

Quality Practices Importance	Project Performance Indication		
Leadership	*Cost*	*Time*	*Quality*
Our leadership team communicates the project vision and strategy to the employees	0.145	0.526	0.368
Our leadership team strongly encourages employee involvement in quality management and improvement activities	0.299	0.486	0.399
Employee Empowerment	*Cost*	*Time*	*Quality*
Our organization has cross-functional teams or quality circles that encourage employee involvement	0.275	0.476	0.451
Customer Focus	*Cost*	*Time*	*Quality*
Our organization maintained relationship with our customer	0.386	0.415	0.517
Continuous Improvement	*Cost*	*Time*	*Quality*
Our leadership team emphasizes the continuous improvement of quality in all work processes at various levels	0.342	0.229	0.347

Multicollinearity test were conducted to analyze the relationship between the quality practices. Table 3 shows that leadership and employee empowerment is significantly correlated. Further study needed to investigate the relationship, which is not covered in this research.

Table 3: Multicollinearity of important quality practices

	Leadership	Employee Empowerment	Customer Focus	Continuous Improvement
Leadership	1	0.852	0.647	0.828
Employee Empowerment	0.852	1	0.657	0.724
Customer Focus	0.647	0.657	1	0.623
Continuous Improvement	0.828	0.724	0.623	1

5.0 DISCUSSIONS AND CONCLUSIONS

From the results, hypothesis developed were verified. The mean value in Table 1 provides indication that leadership is highest and has the greatest influence to the project cost (μ=4.44), time (μ=4.51) and quality performance (μ=4.53) thus, supporting hypothesis H1. Employee empowerment contributes to the project time and quality performance but less to the cost indication. This outcome implies to have

continuous improvement practice. Meanwhile, H2 and H4 are only partly supported. Customer focus relationship with project performance is not significant as perceived in H3.

The results suggest that leadership element is the most important quality practice towards project success [23]. The most important aspect that can be improved is the communication of the project vision and strategy to the employees. It is also essential to involve employees in quality management and improvement activities such as cross-functional teams and quality circles. Besides, leadership team should encourage any suggestions and innovation to the organization. It can be concluded that employees empowerment element also should be emphasize in the quality practice improvement as both leadership and employees is the main driver towards organization performance [14].

The findings show that there are still no significant relationships of customer focus with project performance [15]. These factors were overlooked by the project management as mentioned by Orwig and Brennan [3]. Emphasis of this factor should be considered by utilizing customer feedback as the basis of quality improvement while maintaining the relationship with the customer. Continuous improvement factor is being practiced but can be expanded further by top-bottom involvement and across the level in all work processes. Arumugam, Ooi, and Fong [24] suggest that ISO9001:2000 organizations should emphasize customer focus and continuous improvement factors for quality management performance.

In conclusion, the level of quality practices in the project organization is considerably average and can be improve as per discussion above. The awareness of quality practices has been established but need to be further developed to achieve the performance target. Total quality approach is the key for project performance improvement. The results only represent working level point of view thus, management level feedback is most welcome for future research. This study can be improved further by increasing the number of samples and assessment of more quality factors refinement for TQM application framework to the organization and integration into the current project quality management.

REFERENCES

[1] Youssef, M. A., and Zairi, M. (1995). Benchmarking critical factors for TQM: part II- empirical results from regions in the world. *Benchmarking for Quality Management & Technology, 2*(2), 3-19.

[2] Harrington, H. James, Frank Voehl, and Hal Wiggin. 2012. "Applying TQM to the Construction Industry." *The TQM Journal* 24 (4):352-362.

[3] Orwig, Robert A., and Linda L. Brennan. 2000. "An Integrated View of Project and Quality Management for Project-based Organizations." *International Journal of Quality & Reliability Management* 14 (4/5):351-363.

[4] Cicmil, Svetlana. 2000. "Quality in Project Environments: A Non-conventional Agenda." *International Journal of Quality & Reliability Management* 17 (4/5):554-570.

[5] Ahmad, Mohammad Munir, and Redha Elhuni. 2014. "Critical quality factors for successful TQM implementation in Libyan oil and gas sector." *Benchmarking: An International Journal* 21 (5):713-733. doi: 10.1108/BIJ-06-2012-0045.

[6] Barad, Miryam, and Tzvi Raz. 2000. "Contribution of Quality Management Tools and Practices to Project Management Performance." *International Journal of Quality & Reliability Management* 17 (4/5):571-583.

[7] Bryde, David James, and Lynne Robinson. 2007. "The Relationship Between Total Quality Management and the Focus of Project." *The TQM Magazine*, 50-61.

[8] Hides, M.T., Z. Irani, I. Polychronakis, and J.M. Sharp. 2000. "Facilitating total quality through effective project management." *International Journal of Quality & Reliability Management* 17 (4/5):407-422.

[9] Ingason, Helgi Thor. 2015. "Best Project Management Practices in the Implementation of an ISO 9001 Quality Management System." *Procedia - Social and Behavioral Sciences* 194:192-200. doi: http://dx.doi.org/10.1016/j.sbspro.2015.06.133.

[10] Jung, Yoo Joo, and Yong Jian Wang. 2006. "Relationship between Total Quality Management (TQM) and Continuous Improvement of International Project Management (CIIPM)." *Technovation* 26:716-722.

[11] Ugboro, Isaiah O., and Kofi Obeng. 2000. "Top management leadership, employee empowerment, job satisfaction, and customer satisfaction in TQM organizations: an empirical study." *Journal of Quality Management* 5:247-272.

[12] Yazdani, Alireza, Mohammad Ali Soukhakian, and Mohammad Reza Mozaffari. 2013. "Evaluation of critical success factors in total quality management implementation and prioritization with AHP- case study: Pars oil and gas company." *European Online Journal of Natural and Social Sciences* 2 (3):1624-1633.

[13] Basu, R. (2014). Managing quality in projects: An empirical study. *International Journal of Project Management, 32*, 178-187.

[14] Huang, Fenghueih, and Yao-Tzung Chen. 2002. "Relationship of TQM philosophy, methods and performance: a survey in Taiwan." *Industrial Management and Data Systems* 102 (4):226-234.

[15] Laosirihongthong, Tritos, Pei-Lee Teh, and Dotun Adebanjo. 2013. "Revisiting Quality Management and Performance." *Industrial Management and Data Systems* 113 (7):990-1006.

[16] Singh, Jagdeep, and Harwinder Singh. 2015. "Continuous improvement philosophy-literature review and directions." *Benchmarking: An International Journal* 22 (1):75-119.

[17] PMI. 2013. *A guide to the Project Management Body of Knowledge (PMBOK guide)*. 5th ed. Pennsylvania: Project Management Institute, Inc.

[18] Fotopoulos, Christos B., and Evangelos Psomas. 2009. "The impact of "soft" and "hard" TQM elements on quality management results." *International Journal of Quality & Reliability Management* 26 (2):150-163.

[19] Das, Anupam, Himangshu Paul, and Fredric W.Swierczek. 2008. "Developing and validating total quality management (TQM) constructs in the context of Thailand's manufacturing industry." *Benchmarking: An International Journal* 15 (1):55-72.

[20] Lau, R.S.M., Xiande Zhao, and Ming Xiao. 2004. "Assessing quality management in China with MBNQA criteria." *International Journal of Quality & Reliability Management* 21 (7):699-713.
[21] Nunnally, Jum C. 1978. *Psychometric Theory*: McGraw-Hill.
[22] Pallant, Julie. 2011. *A step by step guide to data analysis using SPSS*. 4th ed: Allen & Unwin.
[23] Parast, Mahour Mellat, Stephanie G. Adams, and Erick C. Jones. 2011. "Improving operational and business performance in the petroleum industry through quality management." *International Journal of Quality & Reliability Management* 28 (4):426-450.
[24] Arumugam, Veeri, Keng-Boon Ooi, and Tuck-Chee Fong. 2008. "TQM practices and quality management performance. An investigation of their relationship using data from ISO 9001:2000 firms in Malaysia." *The TQM Journal* 20 (6):636-650.

Organizational Stress among Operation Department Employees at Offshore Topside Construction

Zafariq Zainal[a] and *Yusof Daud*[b]

Razak School of Engineering and Advanced Technology, Universiti Teknologi Malaysia, 54100 Kuala Lumpur, Malaysia
[a]*zafariqzainal@gmail.com;* [b]*yusof.kl@utm.my*

Abstract – *High costs associated to the employee turnover due to stress problem has initiated the present study. The related stress factors have identified in this study including interpersonal relationship, job characteristics, organizational role and occupational stress. Set of questionnaires was developed and distributed the related employee at Operation Division at Dayang Enterprise Sdn Bhd (DESB). The data were analysed using Statistical Package for Social Science (SPSS) version 21.0 and were tested for its reliability, and followed by frequency analysis, Pearson's correlation analysis, and coefficient regression analysis. This study indicates that job characteristics, interpersonal relationship, organizational role have significant relationship with occupational stress.*

Keywords: Occupational stress, job characteristic, interpersonal relationship, organizational role

1.0 INTRODUCTION

Occupational stress is defined as the response from employee when dealing with work demands and pressures that are not matched to their level of knowledge and abilities that bring strong challenges towards their ability for coping with it at the workplace [1]. Occupational stress can significantly cause an unusual and dysfunctional behavior at work which subsequently contributed to poor physical and mental health [2]. Lazarus, Deese and Osier [3] emphasized that occupational stress occurrence is determined by the effectiveness of job performance that have been contributed by the employee in the organization. In recent research, occupational stress occurrence is determined by the employee psychological strength towards level of concentration, and focus given at work [4].

Preceding research by Huang, Feuerstein and Sauter [5] indicates that most studies have been conducted on the occupational stress, but yet only few have been conducted specifically on identifying antecedents from both individual and organizational based factors influenced towards occupational stress. Furthermore, previous study done by Idris et al., [4] specified that, since the mid-1990s, there were researches conducted pertaining to the occupational stress by only focusing on determining stress factors as human based or organizational based alone.

Based on the justification above, it is evident that previous research on the antecedents of occupational stress had been conducted according to individual based factors such as interpersonal relationship, personal attitudes, personal traits, locus control and others or organizational based factors such as job characteristics, job

demands, organizational structure, organizational roles, and others [6]. However, to the researcher understanding, there is lack of research that had been conducted by combining on both the individual and organizational based factors in nine relations to occupation stress. Therefore, in order to better understand the antecedents of occupational stress, there is a need to combine both the individual and organizational based factors in this study. Additionally, regarding on the established scenario and background pertaining to the antecedents of occupational stress occurrence in the organization, sufficiently to say that, the primary focus of this study is specifically intends to combine both factors from human and organizational based with further understanding on the antecedents that will influence the operation staff of Operation Division towards occupational stress in Dayang Enterprise Sdn Bhd (DESB).

2.0 CONCEPTUAL MODEL

The conceptual model developed for this study was derived from the literature review. In this study, assumptions are made that there is a relationship between factors of interpersonal relationship, job characteristic and organizational role with the occupational stress that occurs among the operational staff in operation division, DESB. Figure 1 shows the conceptual framework that connects independent variables and the dependent variable of the study.

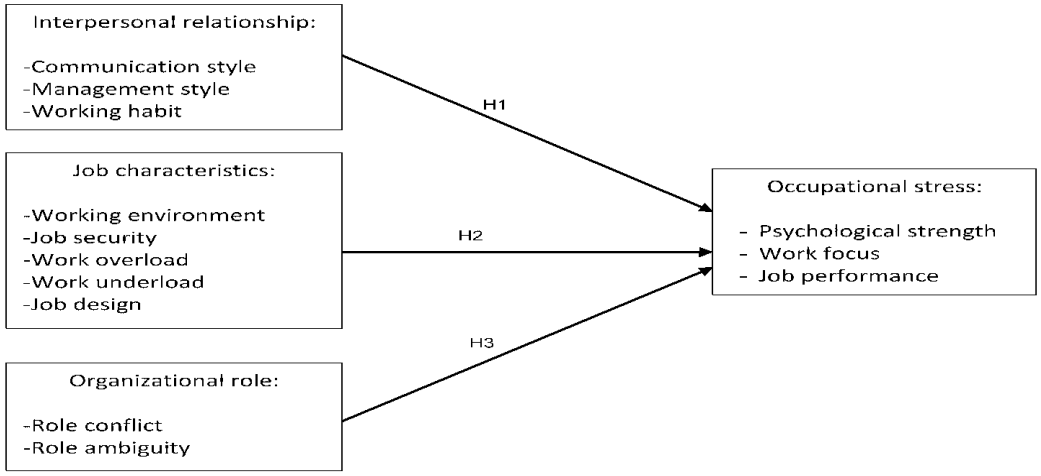


Figure 1: Conceptual Framework for Occupational Stress

3.0 DATA COLLECTION METHOD

The data for this study has been collected via two different sources which were from the primary and secondary sources of data shown structurally in Figure 2. A total of 105 questionnaires were distributed to operation staffs currently attached in the Operation Department.

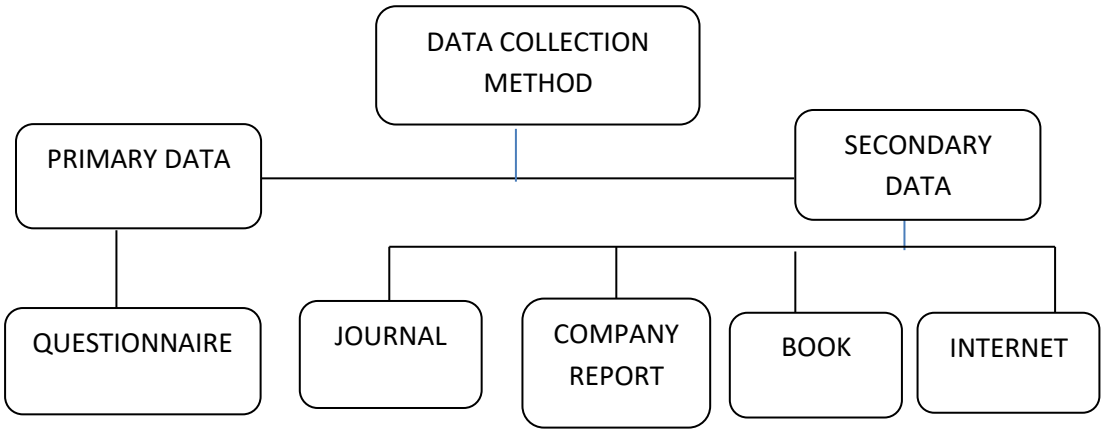


Figure 2: Data Collection Method of the Study

3.0 RESULTS

The statistical analysis covers the reliability, frequency, correlation and regressions. The results are shown in this section. Table 1 shows the demographic data for respondents in DESB.

Table 1: Profile of Demographic

Demographic Variables	Categories	Frequency	Percentage (%)
Gender	Female	33	31.4
	Male	72	68.6
Age	Below 20 Years	3	2.9
	20-30 Years	44	41.9
	31-40 Years	27	25.7
	41-50 Years	22	21.0
	Above 50 Years	9	8.6
Employment Status	Permanent	49	46.7
	Contract	56	53.3
Education Background	SPM/STPM	37	35.2
	Diploma	37	35.2
	Bachelor Degree	26	24.8
	Master Degree	5	4.8
Job Status	Technical Clerk	18	17.1
	Executive	21	20.0
	Manager	17	16.2
	Engineer	49	46.7
Length Of Service	Less than 5 Years	42	40.0
	6-10 Years	30	28.6
	11-15 Years	7	6.7
	16-20 Years	14	13.3
	20 Years and Above	12	11.4

The reliability values of the overall variables based on Cronbach's Alpha is 0.947 and the reliability of each variables are shown in Table 2. The results are all above 0.7 indicating that the findings from this study are reliable.

Table 2: Cronbach's Alpha for each Variable of Study

Variables	No of item	Cronbach's Alpha
Occupational Stress	10	0.802
Job Characteristic	15	0.828
Interpersonal Relationship	14	0.816
Organizational Role	11	0.863

Referring to Table 3, the relationships between occupational stress and job characteristics, interpersonal relationship and organizational role are identified. The highest correlation is between Occupational Stress and Organizational Role at 0.799, while the lowest correlation is between Occupational Stress and Interpersonal Relationship at 0.744. All correlation coefficient are significant at the 0.01 level. Furthermore, the stated sig (2-tailed) values are less than 0.05 indicated that there are correlations between all variables in this study.

Table 3: Coefficient Correlation Analysis

		Occupational Stress	Job Characteristics	Interpersonal Relationship	Organizational Role
Occupational Stress	Pearson Correlation	1			
	Sig. (2-tailed)				
	N	105			
Job Characteristics	Pearson Correlation	.784**	1		
	Sig. (2-tailed)	.000			
	N	105	105		
Interpersonal Relationship	Pearson Correlation	.744**	.855**	1	
	Sig. (2-tailed)	.000	.000		
	N	105	105	105	
Organizational Role	Pearson Correlation	.799**	.730**	.856**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	105	105	105	105

**.Correlation is significant at the 0.01 level (2-tailed).

Referring to Table 4, the p-value result shown independent variables are ≤ 0.05. Therefore, there are significant relationship between organizational role, interpersonal relationship and job characteristic with occupational stress among operation staff in DESB.

Table 4: Coefficient Table of Regression Analysis

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.038	.236		4.405	.000
	Job Characteristics	.508	.091	.554	5.595	**.007**
	Interpersonal Relationship	-.228	.118	-.251	-1.924	**.037**
	Organizational Role	.524	.085	.610	6.150	**.000**

4.0 DISCUSSIONS

The study has found that there are significant relationship between organizational role, interpersonal relationship and job characteristic with occupational stress among operation staff in DESB. From the researchers point of view indicates that when employees experienced with poor relationship among their colleagues, subordinates or even supervisors at the workplace due to internal conflict, negative style of communication among them, poor working habits practiced by employee and also bad management style implemented in the workplace may considerably influence employees to experience on occupational stress in the organization.

From the researchers point of view, when the workplace in an organization have poor working environment, excessive of work, high risk or unsafe jobs and also inconvenience of job design may potentially give pressures for employees and consequently leads to the occupational stress occurrence in the organization.

Based on the research conducted, DESB management needs to put high attention regarding the factors influence the staff towards occupational stress in the organization. Company should plan an efficient and effective stress management program and also taking several actions that can vital help in improving the job performance among the staff as well improving company efficiency aligning with the goals and objectives to be achieved. Occupational stress certainly may contribute to multiple individual problems and have been associated with decrease psychological health, disrupted level of focus and subsequently may lead to decrease job performance among the staff in the organization.

This study shows that in conducting an effectiveness of stress management strategies and actions should be taken by the management, and the antecedent of organizational role need to be given more attention, since this factor is the most important factor to influence occupational stress occurrence among staffs and apparently they are facing with the role conflict and role ambiguity at work. DESB needs to establish clarity of expectations to their staff as they should let all of the staff to know on what is really to be expected from them in terms of appropriate workplace behaviours and roles to be executed.

Additionally, management can take an effective actions to handle the problem by promoting a respectful workplace environment where the employee and employer need to support for one another and working as one team unit and also set collective goals to be achieved. Another initiatives that should be taken by the management for seeking conflict resolutions at the workplace is that they need to ensure that all parties to a conflict have an equal voice and have equal chance to speak on giving their arguments and explanations when dealing with a conflict regardless of their job position, length of service or educational background [7].

5.0 CONCLUSION

This study has eventually managed to determine the most essential factors influences on occupational stress occurrence among staffs which are the interpersonal relationship, job characteristic and also organizational role. In conclusion, certainly there are some positive impacts can be achieved when main stressors of occupational stress have been successfully being overcome by the management of the organization which substantially it could trigger on improving psychological health among the staff, maintain high level of focus at work and also it would boost on sustaining job performance to increase business opportunities. Basically, the impact might differ and depends on the particular types of stress management strategies that been practices and used on handling the occupational stress and the extent of actions to be taken relatively concerns whether the initiatives are being effectively works and could give positive results in the organization.

REFERENCES

[1] Game, A. M., "Workplace boredom coping: health, safety, and HR implications." Personnel Review 36, no. 5 (2007).
[2] World Health Organization, website, http:www.who.org (2013).
[3] Lazarus, R. S., Deese, J., and Osier, J. F., " The effects of psychological stress upon performance." Psychological Bulletin 49, no. 5(1993): 293-316.
[4] Idris, M. A., Dollard, M. F., and Winefield, A. H., "Lay theory explanations of occupational stress: the Malaysian context." Cross Cultural Management: An International Journal 17, no. 2 (2010).
[5] Huang G. D., Feuerstein, M., and Sauter S. L., "Occupational stress and work-related upper extremity disorders: concepts and models." American Journal Ind. Med. 4, no. 1(2002): 298-314.
[6] Alves, S. L., "A study of occupational stress, scope of practice, and collaboration in nursenesthetists practicing in anesthesia care team settings." Journal American Association of Nurse Anesthetists 73, no. 6(2005): 443-52.
[7] De Dreu, C. K. W., and Beersma, B., "Conflict in organizations: Beyond effectiveness and performance." European Journal of Work and Organizational Psychology 14, no. 2(2005): 105-117.

Index

Master Project Symposium Organizing Committee
UTM Razak School of Engineering and Advanced Technology
Universiti Teknologi Malaysia
Jalan Sultan Yahya Petra
54100 Kuala Lumpur
MALAYSIA
Phone: +603-2180 5138; Fax: +603-2180 5380

ISBN 978-967-13383-4-6