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Table of Contents

JURNAL KEJURUTERAAN, TEKNOLOGI DAN SAINS SOSIAL POLITEKNIK UNGKU OMAR, FEBRUARY 2021
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WORK MEASUREMENT AND MANPOWER PLANNING IN PROCESSED BIRD PACKING

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Abstract: The aim of this project is to study the work measurement and manpower planning in processed bird packing unit in an industry for food processing, where poultry is the main business. In this study, it was found the marinating unit in the company was facing problems with production delays due to poor manpower arrangement. In order to overcome these problems, the workforce productivity was measured using work measurement method. The objective of this research is to study the manpower efficiency at marinating unit. Time study was used as the method for work measurement. New manpower planning schedule was designed to increase the daily production in line with the company Key Performance Index for the marinating unit.

Keywords: *Work Measurement, Time Study, Manpower Planning*

1. Introduction

Company wants to increase output as the management is targeting on achieving its goal of generating 240,000 birds per day. However, the company faces delays in certain section making it difficult for the company to reach its daily target. One of these sections is the marinating unit. Workers are not able to achieve the target which is 8 packs per minute in order to meet the desired level of production daily. On a daily basis there has been an increase in overtime to unsure targeted daily production is achieved. Due to these scenarios the production team decided to study on arrangement of manpower in marinating unit as the current one is inefficient. Work measurement is one of effective tool to increase productivity of a company which is the aim of company after moving to a new production plant. Work measurement is a technique that measures the time of a qualified worker with necessary skills, knowledge and physical strength to perform a specific task or job (Abdul and Daiyanni, 2010). Time study is one of the work measurement technique where time taken for worker to finish a particular task under certain condition is recorded (Duran et al., 2015). The objectives of this study were to study the manpower efficiency at marinating unit of DPP, to design a new manpower planning schedule and to analyse productivity data before and after implementation of the new manpower planning schedule.

2. Methodology

2.1 Time Study

Time study is useful for determination of time required for skilled worker to perform a task while working at an average pace (Lusia, 2016). International Labour Organization describes time study is one of the work measurement technique where time taken for worker to finish a particular task under certain condition is recorded. Time study is useful technique to increase

the productivity by determining standard time (Lusia, 2016). Time study is used to dissect a procedure by competent workers with the aim of locating the most time-consuming productive routes. The time is usually estimated using snapback stopwatch technology because information collection is simpler, faster and used to generate accurate information (Wajiga and Ndaghu 2017). It allows the time of the part to be recorded conveniently on the timesheet without subtraction. This stopwatch method is using the speed rating. Speed rating is a tool to determine the fast and slow worker. Each worker will be given the same task for processed bird packing. The number of pieces packed by a worker in one minute will be recorded for every worker. From this, the speed of performing the task and performance level of each worker will be known. There will be four workers performing packing task positioned in a row to ease the process and make the flow of task smoother. The four packers will be arranged according to their performance level following a decreasing trend. Time study was conducted three times a day.

2.2 P-D-C-A Cycle

The problem-solving method used in this study is PDCA. First, the Plan is to discuss the objectives of this project and the ways to achieve the objectives. Time study was used for work measurement and productivity data was created for data collection and new manpower planning schedule was designed. The second is Do which is implementation of new manpower planning design. The third is Check which is set the time for data analysis and results obtained from after the implementation of new manpower planning design. Lastly is Act where some changes were made to the new manpower planning until the new manpower planning design has successfully increased the number of packs packed by each worker in a minute and able to reach the target which was 8 packs per minute (Mindtools, 2020).

2.3 Processed Bird Packing Layout and Manpower Planning

Figure 1 shows the current layout of processed bird packing group has total of seven workers doing several different tasks. Firstly, the task of a grader is to sort and grade the chicken parts where chicken parts will be sorted into 4 different parts and damaged parts will be rejected. Next task is done by packer where the sorted chicken parts will be packed inside a food packet. Moving on to the next task will be done by the sealer where the food packet will be sealed using a hot temperature sealing machine. Two graders are positioned at two corners of the tote bin facing each other. Three packers are positioned at one side of tote bin (P1, P2 and P3) and another packer (P4) is positioned next to one of the graders on the left side. The sealer is positioned next to the packer and grader on the left side. The problem with this layout is the position of the packer stationed next to the grader on the left side. The flow of the packing task takes more time due to the position of P4. The time to pass on the packet between P3 and P4 takes longer time because P4 is stationed far from P3. The distance between P3 and P4 is longer than the distance between P2 and P1, P2 and P3.

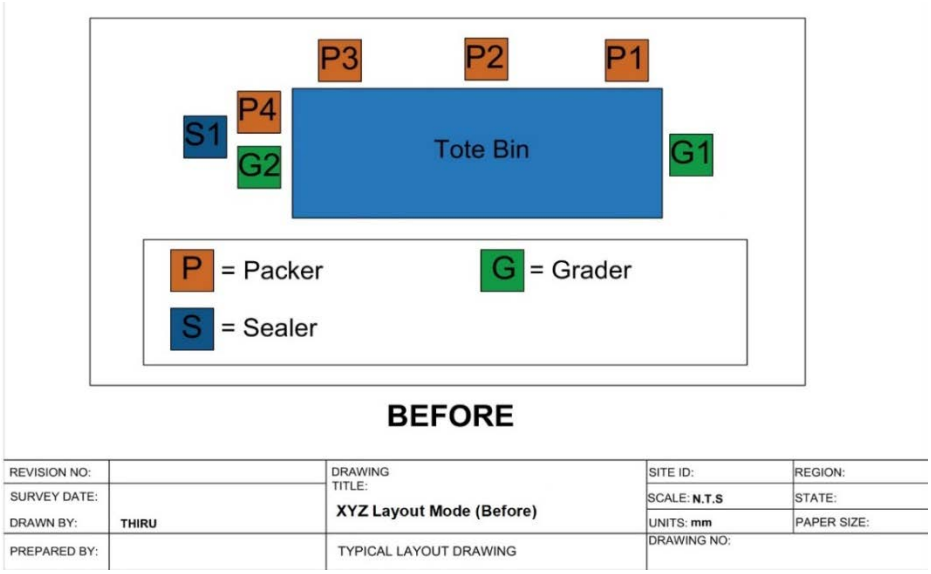

Figure 1. Processed bird packing layout before manpower planning

Figure 2 shows several changes made to the new proposed layout considering that some packers could not reaching the target number of packs. Initially, P4 was stationed next to Grader (G2) and away from other packers. To ease the flow of the packs from one packer to another, P4 was placed in the same row as the other packers. The sequence of workers was arranged in increasing order of task performance. First packer must be the fastest and with best task performance. When the first packer packs fast, it will provide more time for other packers with lower level of task performance to finish their task and the whole process will be done at faster pace. Hence, the sequence of packers in newly proposed layout was P2, P1, P3 then last worker will be P4.

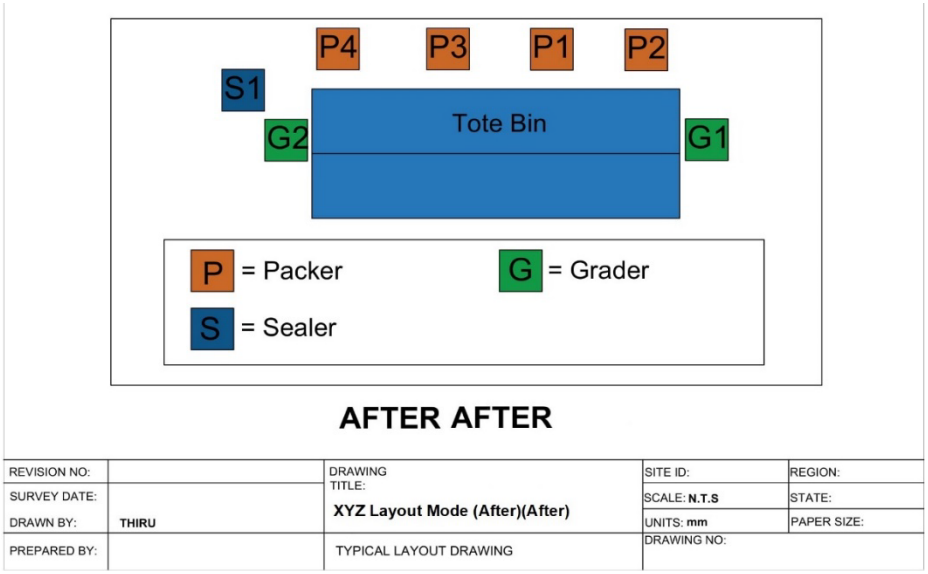

Figure 2. Processed bird packing layout after manpower planning

2.4 Data Collection

The data on efficiency were determined by the work. The data collected 3 times per day are performance results. Data sheet was used to record the number of packs packed in one minute by P1, P2, P3 and P4. Three readings were taken to get average per session. Three session were included in the data sheet together with number of manpower. Data was collected at different timing as the work performance differs throughout the day. It took nearly five weeks to collect the data. Test data was collected for 1 week and exact data was collected for 4 weeks. First 2 weeks of data collection was done before the implementation of manpower planning. The data were then analysed to design a new manpower planning schedule. The next 2 weeks of data collection was done after the implementation of new manpower planning. Test data was taken to verify that data is collected in the correct way and at the right time. The stopwatch was used for data collection in this project.

3. Results and Discussion

The percentage was calculated to find the difference between the average number of packs packed by each worker in week 1 before manpower planning and after manpower planning. Percentage difference will show the outcome trend of the manpower planning to find out the effectiveness of implementation of manpower planning as refer to Equation 1 (Yusoff et al., 2012).

$$Percentage\ difference = \frac{Difference\ (week\ 1\ after - \ week\ 1\ before)}{week\ 1\ before} \times 100\ \% \quad (1)$$

Table 1 tabulates the percentage differences of effectiveness in week 1 after manpower planning implementation.

Table 1. Difference between average of week 1 before manpower planning and after manpower planning and percentage increase.

Descriptions	P1	P2	P3	P4
Average for Week 1 before manpower planning	7	8	7	6
Average for Week 1 after manpower planning	11	12	11	10
Difference (week 1 after - week 1 before)	4	4	4	4
Percentage (%)	**57.14**	**50.00**	**57.14**	**66.67**

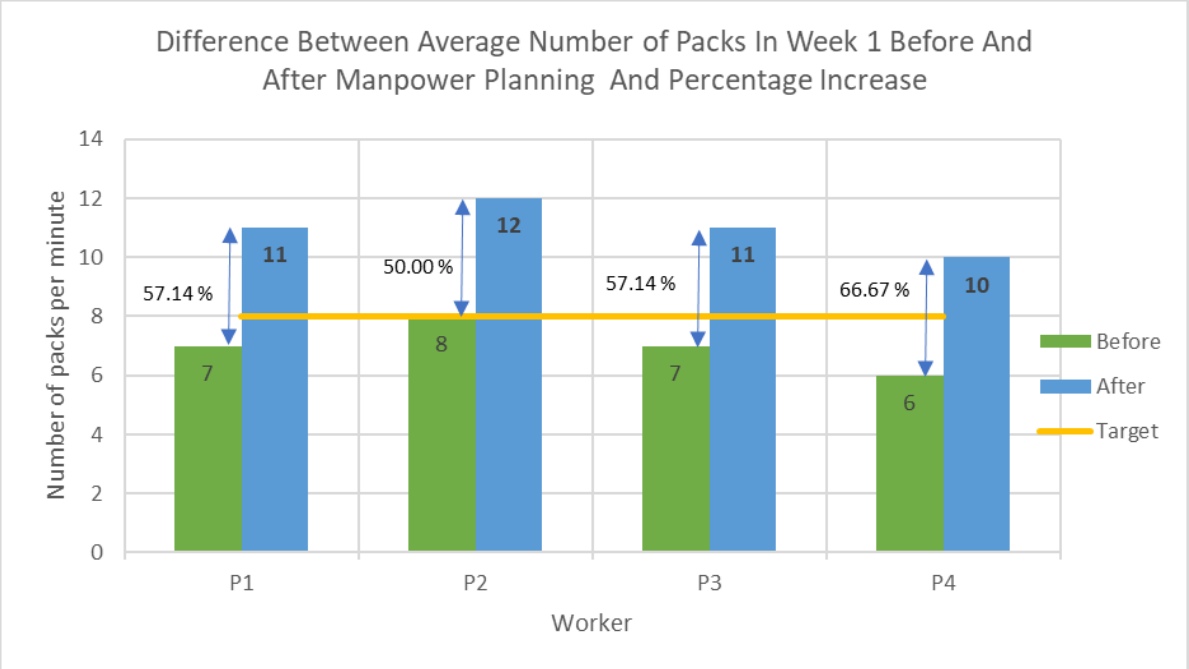

Figure 3. Average number of packs per minute in week 1 before and after manpower planning for P1, P2, P3 and P4 with percentage difference

Figure 3 illustrates the graph of average number of packs per minute in week 1 before and after manpower planning for P1, P2, P3 and P4 with percentage difference. The average packs per minute in week 1 for P1 has increased by 4 packs after manpower planning. It has increased 57.14 % compared to week 1 before manpower planning. The average number of packs for P2 has gone up to 12 packs per minute and has increased 50 % compared to week 1 before manpower planning. As for P3, the average number of packs has elevated from 7 packs per minute to 11 packs per minute by 4 packs after manpower planning which increased 57.14% compared to before manpower planning. Average number of packs for P4 has increased dramatically by 66.67% after manpower planning. The average increased form 6 packs per minute to 10 packs per minute, considered as the evidence for success of manpower planning.

Table 2 tabulates the percentage differences of effectiveness in week 2 after manpower planning implementation.

Table 2. Difference between average of week 2 before manpower planning and after manpower planning and percentage increase.

Descriptions	P1	P2	P3	P4
Average for Week 2 before manpower planning	8	9	8	6
Average for Week 2 after manpower planning	11	12	10	10
Difference (week 2 after - week 2 before)	3	3	2	4
Percentage (%)	**37.50**	**33.33**	**25**	**66.67**

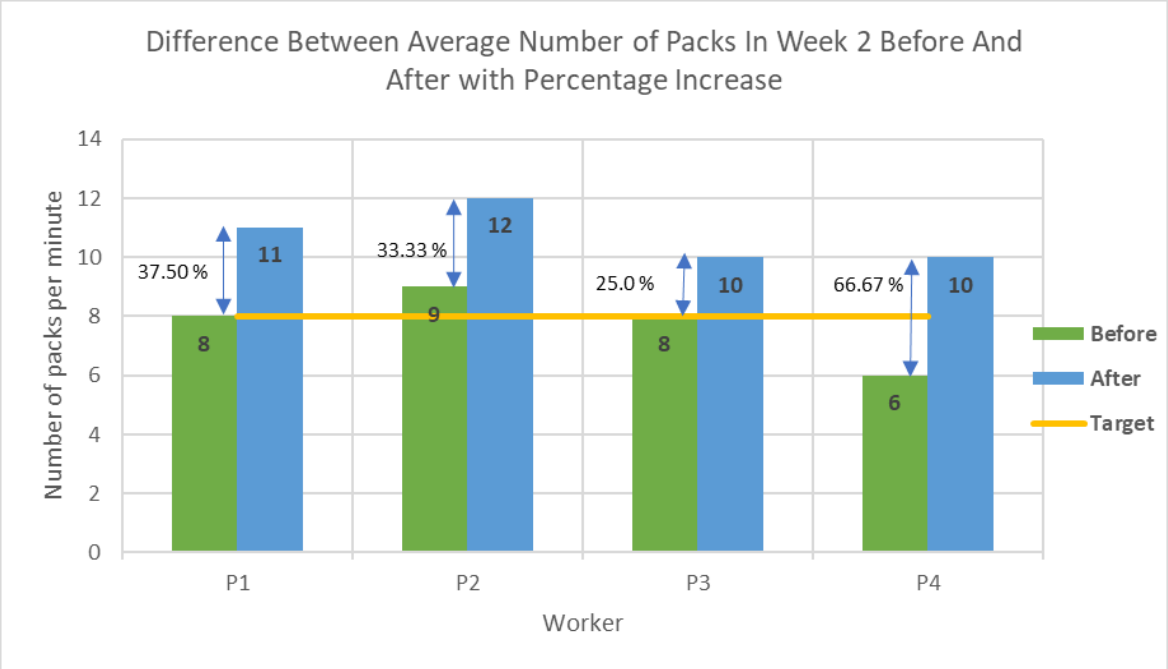

Figure 4. Average number of packs per minute in week 2 before and after manpower planning for P1, P2, P3 and P4 with percentage difference.

Figure 4 illustrates the graph of average number of packs per minute in week 2 before and after manpower planning for P1, P2, P3 and P4 with percentage difference. The average number of packs in week 2 for P1 has increased from 8 packs per minute to 11 packs per minute which has increased by 3 packs and 37.50% after manpower planning. As for P2, the average has increased by 3 packs, 33.33% from 9 packs per minute to 12 packs per minute after manpower planning. Moving on to P3, the average has increased by 25% from 8 packs per minute to 10 packs per minute in week 2 after manpower planning. P4 has shown dramatic increase in average number of packs from 6 packs per minute to 10 packs per minute equivalent to 66.67%.

4. Discussions

In week 1 after implementation of manpower planning, percentage increase is more than 50% for all 4 workers. The difference between number of packs packed in a minute in week 1 before and after implementation of manpower planning is 4 packs per minute for all 4 workers. As for week 2 after manpower planning, the percentage increase is between 25% to 38% for 3 workers compared to week 2 before manpower planning. Difference in number of packs packed per minute in week 2 after manpower planning is 2 to 3 packs per minute for 3 workers. P4 has shown highest increase in average number of packs from 6 packs per minute to 10 packs per minute equivalent to 66.67% in week 1 and week 2 after manpower planning. As a result, productivity has increased and issue with overtime has been solved with reduced overtime among workers.

5. Conclusion

All the objectives of this project had been successfully achieved. Time study as work measurement was suitable method to observe workers activity and performance. The productivity data obtained from time study was useful to clearly point out the problems which

was the manpower arrangement. Manpower planning is important in an organization where it helps in optimize the use of human resources available. In this project, new manpower planning design was a success. It successfully helped in making a massive change in productivity data after the implementation of new manpower planning schedule. The new manpower planning design has successfully increased the number of packs packed by each worker in a minute and able to reach the target which was 8 packs per minute which solved the problem faced by the company.

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STUDY ON NEW IMPROVEMENT METHOD FOR ASSEMBLY BLOW PROCESS

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Abstract: This project is to study on new improvement method for assembly blow process. Assembly lines have a 1 section line place (Assembly Small Line) company shrinks the operation of Blow Operation at another place. For Blow have 2 division of operation its Assembly Blow & Injection Blow. For current plan, Assembly Blow shall transfer to place 1st followed by Inject Blow. The objective of this research is to implement optional manpower for variables parts on blow assembly process at b1, to study increase UPH by improved process line B4, to improved capacity study and capability by improved the process line B4. The data about optional manpower were collected by using this geometric symbols are in fact a common knowledge in Japan like we all understand in occident the meaning of a tick (done, correct, passed) and a cross (not good) that used an observation an interview to twelve employees of the company. From the result obtained, it was found that three employees were achieve maru and nine employees were achieved peke for legend. Another step for improved UPH by line B4 is a skip the process, performed by 'walk through' inspection at the standing workstation areas. Improved UPH by line B4 involved only to improve capacity study and capability by improved the process line B4. Capacity study is considered as capacity line utilization in a company. Capacity study function is to easy for company to know the balancing of line capacity to run another part or item. Capacity study plays a big role in a company. This capacity study has provided by production planning and control department. Inside the capacity study have a few data that importance to run the capacity study. The result of evaluation showed that the level of employee's performance was still good. Production planning and control management need to be provided so that it will have a great performance manpower and line utilization at workstations.

Keywords: *assembly, operation, blow*

1. Introduction

Blow molding is the business-relevant polymer production process used in hollow plastic goods manufacturing. It is the third most important plastics forming activity only behind injection molding and economic advantages particularly when compared with injection molding in the manufacture of plastic products. Some of the most popular benefits of blow molding is the ability to mold articles with curves re-entrant (walls built to turn inwards towards the center). It enables the molding of extremely complex and irregular shaped pieces. A plastic hot tube, known as parison or pre-form, starts with this process. Within a split mould with a hollow cavity the parison is set. The sides of the mold are then bound together, pinched and the parison tube screened. Air is pumped into the tube that extends the heat wall to cavity shape; the mold is refreshed with water that solidifies the resin to component size. The component will be removed from the mold after cooling and cut.

2. Literature Review

2.1. Auto Industry

Auto parts industry in Malaysia is a booming industry which encompasses areas of activities from car manufacturing to dealing with auto business with foreign countries (Adams & Ebert., 1978). Auto parts industry in Malaysia is one of principal producers and exporters of vehicle parts, components and accessories, which are widely accepted to most of the leading countries of world. Foreign countries like Japan, UK, Thailand, Taiwan, Singapore, Indonesia, are major importers of Malaysian auto parts. Leaders of automotive manufacturing companies like Mercedes, Suzuki, Ford, General Motors, Mazda, Nissan and Mitsubishi are using Malaysian automotive products and accessories such as seats, springs, and absorbers because of their high quality and competitive prices (Adams and Ebert, 1978).

2.2. Assembly Line

Assembly lines are flow oriented production systems which are still typical in the industrial production of high quantity standardized commodities and even gain importance in low volume production of customized products **(**Imaga**,** 2003). Among the decision problems which arise in managing such systems, assembly line balancing problems are important tasks in medium-term production planning. assembly line consists of workstations arranged along a conveyor belt or a similar mechanical material handling equipment (Scholl and Klein, 1999). The jobs are consecutively launched down the line and are moved from station to station. At each station, certain operation sare repeatedly performed regarding the cycle 9time (maximum or average time available for each work cycle). The decision problem of optimally partitioning (balancing) the assembly work among the stations with respect to some objective is known as the assembly line balancing problems (ALBPs). Manufacturing a product on an assembly line requires partitioning the total amount of work into a set of elementary operations named tasks. Performing a task takes a task time and requires certain equipment of machines and skills of workers. Due to technological and organizational conditions precedence constraints between the tasks have to be observed. These elements can be summarized and visualized by a precedence graph.) The originally define assembly line as “assembly lines were developed for a cost-efficient mass production of standardized products, designed to exploit a high specialization of labor and the associated learning effects **(**Scholl et al., 1998**)**”. Under the term assembly line balancing (ALB) various optimization models have been introduced and discussed in the literature, which are aimed at supporting the decision maker in configuring efficient assembly systems. “Subsequent works however, more and more attempt to extend the problem by integrating practice relevant constraints, like u-shaped lines, parallel stations or processing alternatives” **(**Scholl et al., 1998).

3. Methodology

3.1. Research Strategy

The procedure for implementing the first state method intended for this project is to have a question and answer session with industry supervisors. First, the boss is concerned about what kind of issue that occurred in the business and instead need to do investigation inside the shop floor. Next is to define the problem and review all the previous recent changes, Use the testing method to find a suitable assembly blast line and collect all the data afterwards. The proposed assembly line is early if there is a failure in the initial assembly line. Methodology is detailed project preparation. The technique is to be planned as best as possible for smooth running of

the project. By this, each level of the project does not depart from the defined path or, to be more precise, the study results do satisfy the requirements of the problem to be solved. It is therefore necessary to learn and comprehend in depth the processes that exist in the research methodology framework. Stages of methods used in this analysis.

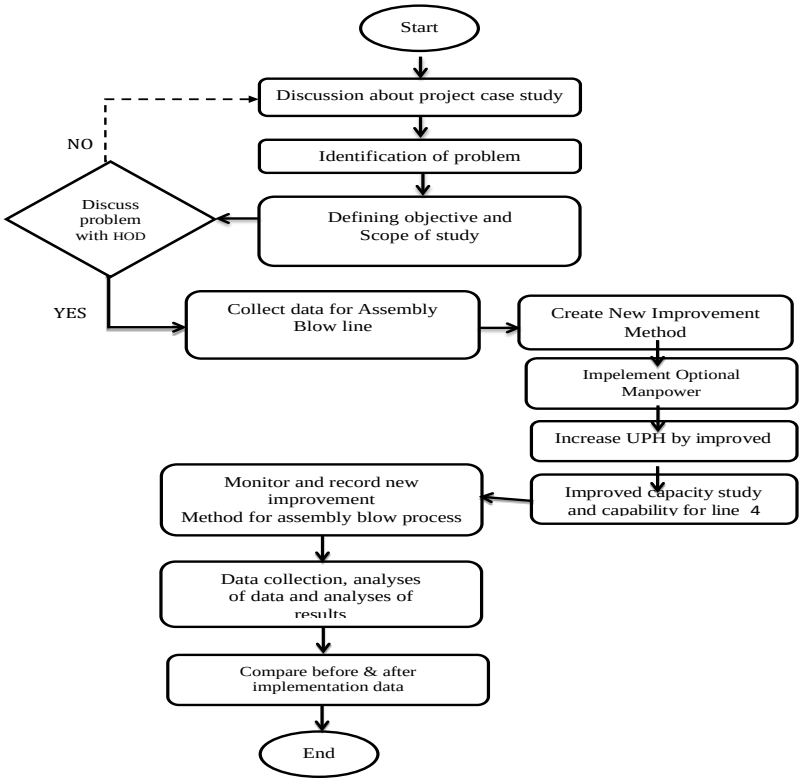

Figure 1. Project methodology

Figure 1. shows that the beginning of project methodology needs to discuss about project case study. Next, identification of problem, defining objective and scope of study. Before this, discuss the problem with head of departments if Yes can proceed it and if No find the new discussion about project case study. Then, collect data for assembly blow line must be tally with your objective and scope. Create new improvement method and select the objective need to provide your project case study. Monitor and record new improvement method for assembly blow process. Finally, data collection, analyses of data and analyses of results to do compare before and after implementation data.

3.2. Optional Manpower

The Optional manpower is for new manpower skilled (B1) of assembly blow line. If the cycle time of original line is break, that means we need to new manpower for backup that suitable with tool and it is call OPTIONAL MANPOWER. Without optional manpower, normally company the line (B1) the line can't run operation or run with no skill manpower. Which is any abnormality during run cannot be detected. If the original manpower is absent, company can use Optional manpower, for fine the suitable manpower company needed do a training process. Therefore, training is a systematic process of altering employees' behavior, knowledge and motivation in order to increase their effectiveness and achievement of organizational goals. The goal of personnel development is to make it possible for the employee to reach the top or achieve the best in his career. Figure 2 shows that schedule Optional Manpower using the legend common knowledge in Japan like we all understand in occident the meaning of a tick

(done, correct, passed) and a cross (not good) that used an observation an interview to twelve employees of the company.

Figure 2. Schedule Optional Manpower

3.3. Unit Per Hour

The emphasis in this research is on defining cycle time as the indicator of a business cycle from start to finish. The time of production refers to production activities, such as the total time necessary for manufacturing a product. Cycle time tells us how much time it takes for a single job to be carried out, from cycle time to Unit per hour. Unit per hour (UPH) is the complete output of the products or finishes in one hour as refers to Equation 1**.**

$$\text{Unit per hour (UPH)} = \frac{3600}{\text{Cycle time}} \tag{1}$$

3.4. The Rate of Operation

Operating rate is the percentage of the total production capacity of a used business, sector, or region. The utilization rate of the factory is identical with the rate of operation. Operating rate is the amount to be met by output to ensure no downtime. The rate of service is correlated with the assembly line as refers to Equation 2.

$$\frac{\text{Actual}}{\text{Plan}} \text{ X } 100 \tag{2}$$

3.5 The Rate of Rejection

The rate of rejection is the percentage of manufactured parts rejected, for a fixed period of time or a lot of bits. Each part production in industries does not achieve its expected quantity, so the company will only allow 3% dismissal at each part production. The rate of rejection as refers to Equation 3.

$$\frac{\text{Total Reject}}{\text{Total Output}} \text{ X } 100 \tag{3}$$

3.6. Net UPH

Net UPH consider rejected item during process of assembly. Unit per hour only count total production done by employee or assembly line, every production process has been recorded. Net UPH considered rejection part in the process, this is because rejection part is not an output or finish good. This method makes output data more accurate by minus it with reject part, actual output that can be used is recorded. The Net UPH as refers to Equation 4.

$$\frac{\text{Gross UPH} \times \text{Operation Rate}}{100 - \text{Rejection Rate}} \tag{4}$$

3.7. Required Working Time

Under the general Working Hour Act provision, regular working hours shall not exceed eight hours per day or 40 hours per week. The general law does not preclude arrangement of working hours where the working hour is shorter than the above. The general clause also requires work hours to be spread over longer periods of time, allowing for a six-day working week. For this particular working hour, means the total time needed to meet a single customer request. The required working time as refers to Equation 5.

$$\frac{\text{Monthly Request}}{\text{Net UPH}} \tag{5}$$

3.8. Available Working Hour Per Month

Working hour can be calculated over a longer period of time, based on an average. In this arrangement, weekly working hours can be calculated so that they balance out on average for an adjustment of 52 weeks to no more than 40 hours a week. The period of adjustment may be shorter, too. In this study, working hours were already shorter less than one month or 4 weeks, because customer demand usually occurs within a month. The available working hour per month as refers to Equation 6.

$$(\text{WORKING HOUR PER DAY} \times \text{WORKING DAY}) + \text{OT} \tag{6}$$

3.9. Legend of Chart

This geometric symbol is in fact a common knowledge in Japan:
Simple circle ○: Called "maru" the simple circle means satisfactory or good. If in the same document the circle and bullseye is used, circle means satisfactory else it means good.
Triangle △: Called "sankaku" the triangle means "weak", "average" or "in progress". If bullseye is used in the same document, it means "weak" else it means "good". In some cases, for tracking progress of an action plan it can means "in progress".
Cross X: Called "peke" the cross means "bad" (Japanese people say "No Good"). This is the easiest symbol to understand because it has the same meaning for us too.

4. Results

As can be seen in Figure 3, result in line b1 summary is divided into 12 person data such as total for individual, before 3 monthly company manpower summary and after 3 monthly data collection manpower summaries. The line B1 summary from Manpower Assembly Blow Line B1.

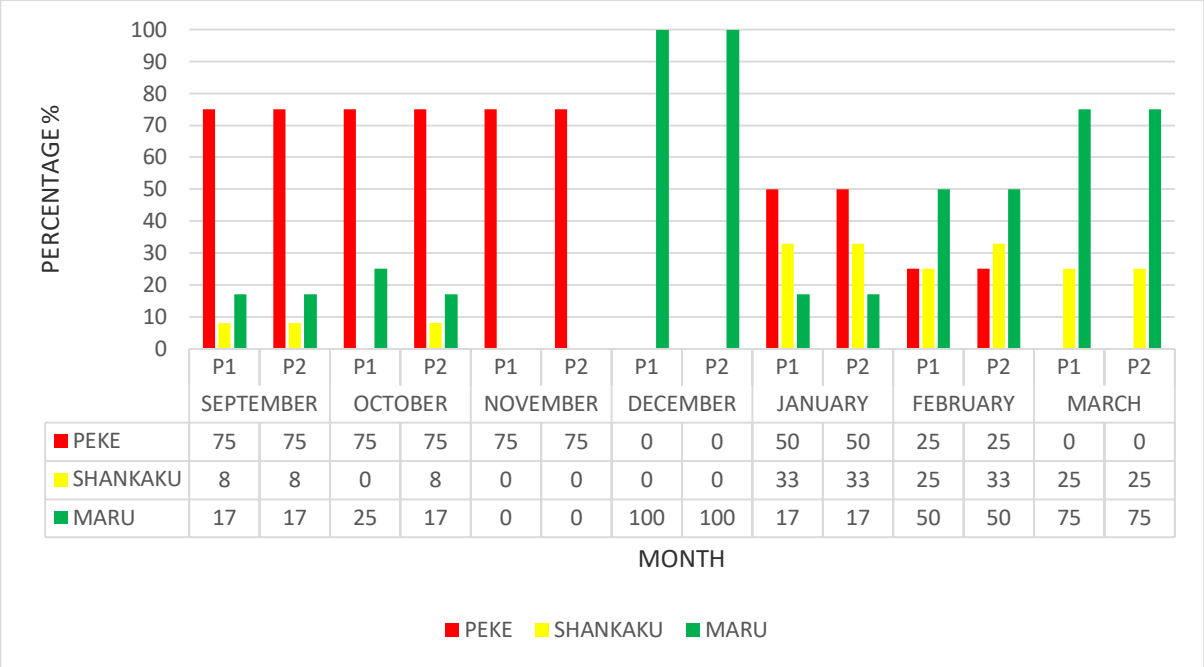

Figure 3. Result Optional Manpower

4.1. Improved UPH

As can be seen in Figure 4, result in line B4 summary is divided into 12 person data such as total for individual, before 3 monthly company manpower summary and after 3 monthly data collection manpower summaries. The line B1 summary from UPH Assembly Blow Line B4. Graph shows that targeting for company in line b1 plan 20 UPH. For the before three months actual for September is 12, October is 14 and November is 15. After the implementation, graphs shows that, UPH for B4 is increasing for each month. January is 17, February is 14 and March is 20. So, the implementation for UPH at B4 usually is successful.

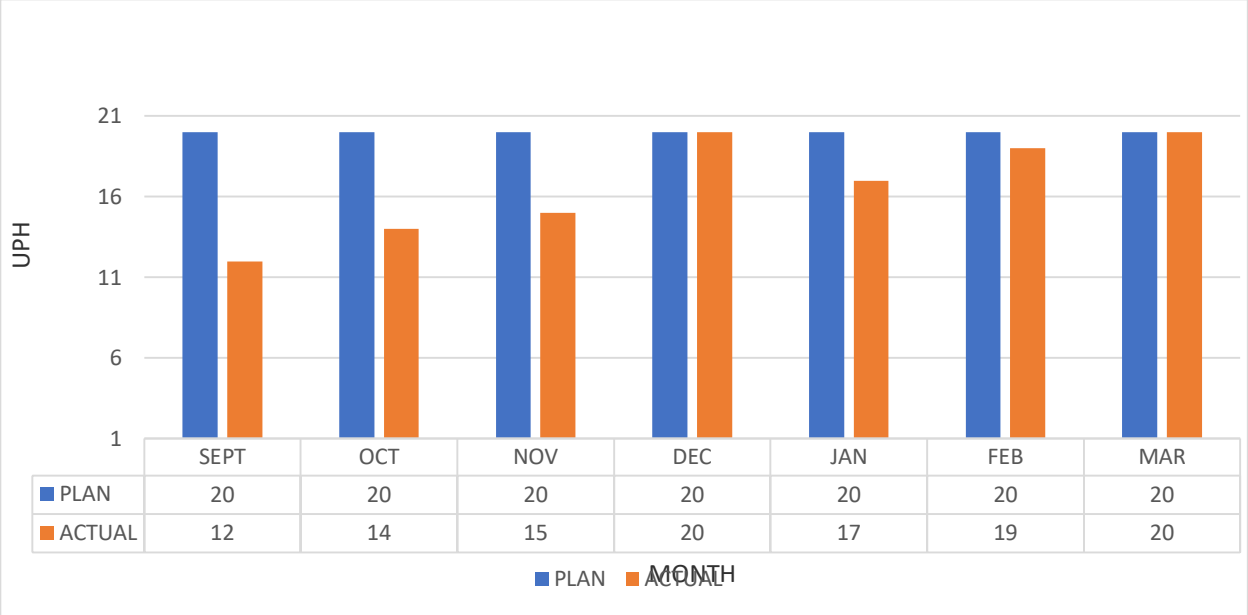

Figure 4. After Implementation UPH B4

4.2. Line Utilization

Line utilization is the percentage production for the selected assembly line in a month term. Following data will show line utilization before using the new UPH for line B4 for one production of Duct Assy Heater to Register. As can be seen in Figure 5, line utilization improved January, February and March. Besides that, as you can see result for before and after is very different. The graph shows the summary line utilization B4. Before three months sets of data were recorded in a day using capacity study. The first sets, which were recorded after the production started on morning shows plan 85 %, followed by second sets which, were recorded before lunch period. The final sets show lower productivity compared to other two sets. On March, the third set shows higher productivity due to the efficient manpower for line B4.

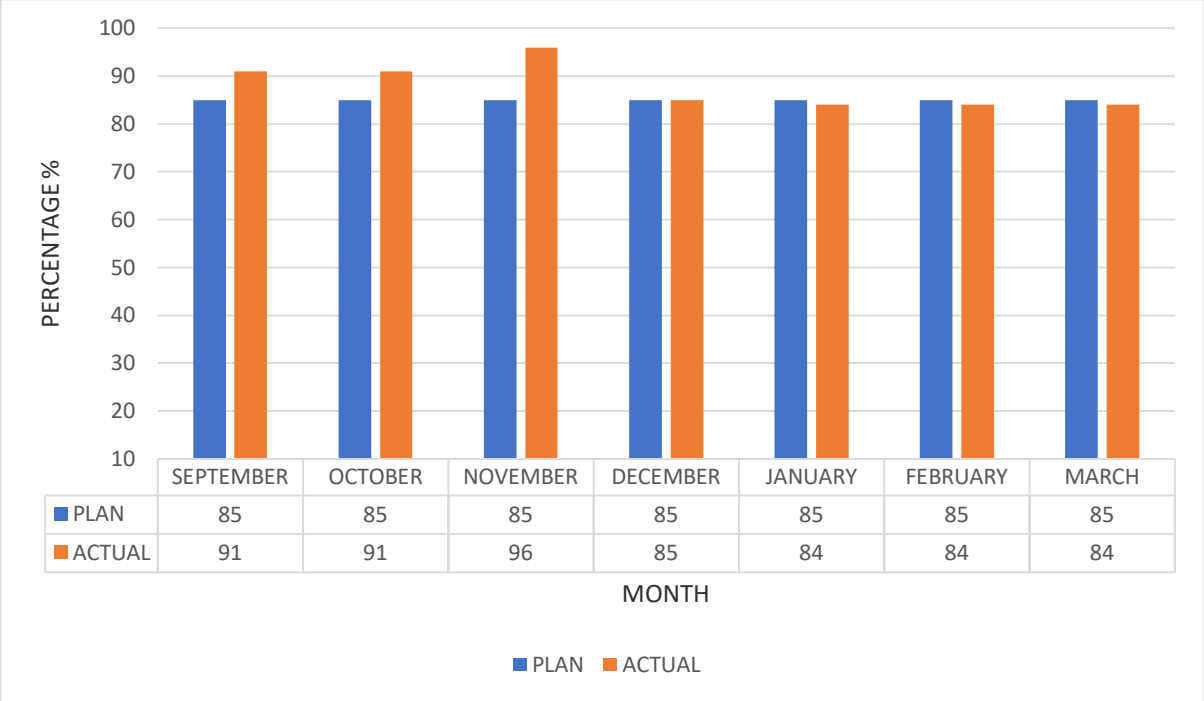

Figure 5. Summary for Line B4 for Utilization

5. Discussion

From the findings, improvement for assembly blow lines must be change the new results. As a you can see, base on Overall Equipment Effectiveness (OEE) method, maximum percentage that acceptable for the assembly line utilization is 85% and the remaining 15% is the idle time for the manpower. If the utilization of assembly line more than 85%, optional line needs to implement to reduce the utilization and balance the production to make sure downtime not happen.

6. Conclusion

The objective is achieving. Capacity study has a lot of advantage for manufacturing company that have high production. By using the balancing of capacity, all assembly line can be used to the optimum level without any waste. This is also can avoid and minimize overtime production that lead to cost saving. Other than that, optional manpower is the way to back up

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DEVELOPMENT OF MONTHLY ORDERING SHEET TABLE (MOST) FOR BLOW MOLDING PROCESS

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Abstract: Monthly Ordering Sheet Table also known as Material Requirement Planning in other company. Its function almost same related to material use in producing products in every industry and it also computer based system. Microsoft Excel have been used and it formula, Vlookup function have been chosen to carry out this study. Vlookup is stand for Vertical lookup which is its function can ease the user who need to key in many data.

Keywords: *Material Requirement Planning, formula,*

1. Introduction

Monthly Ordering Sheet Table (MOST) is a system using by PIC Material Requirement Planning (MRP) which is function to calculate material and child part needed to manufacture product also identify the needed and scheduling of purchase (Sagbansua, 2010). The product's raw material, parts, and other elements are classified as dependent demand. There is a need for a new approach rather than the traditional inventory management methods to meet this kind of demand. The disparity in inventory management stems from the disparity in the market structure for certain items. The demand for goods such as raw materials and parts used in finished product production is called dependent demand. For example, because the demand for parts and components needed for automotive production depends on the amount of demand for the car, it is known as dependent demand.

2. Methodology

2.1. MOST project framework

A conceptual framework focuses on the main scopes to the studied, the factors or variables and the presumed relation between them or, in other words, something which explains the main things to be studied, either graphically or in narrative form. Through theoretical structure, we refer to the conscious and deliberate outcome produced by a researcher in terms of theory or a combination of theories that direct his research effort. Therefore, from the previous section, the aim of this section will be to summarize, review the related major concept, and also to summarize the key theories used in the research study.

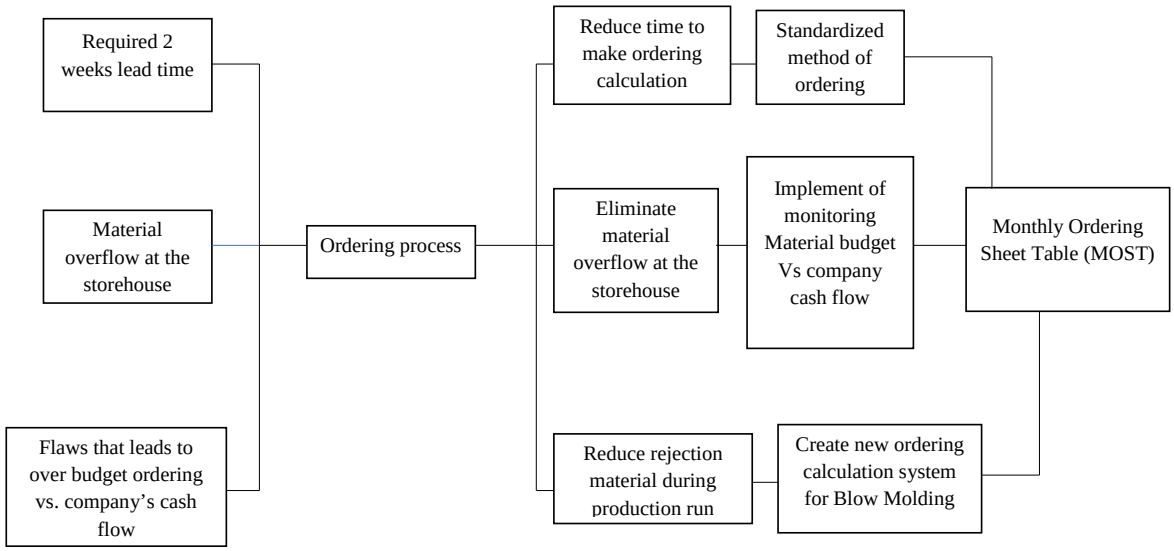
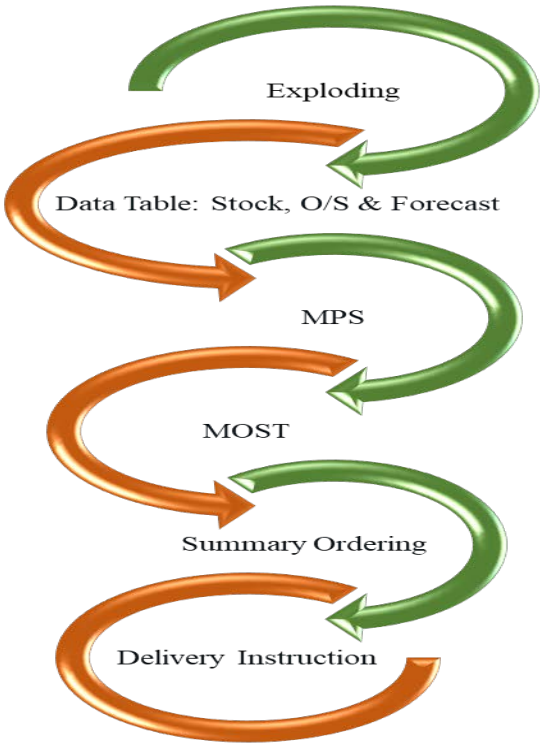


Figure 1. Project Framework (Ermoshin et al., 2018)

2.2. Methods used in Material Requirement Planning



1. BILL OF MATERIAL
   - Master data for ordered parts
2. STOCK AND O/S DATA AND FORECAST TABLE
   - Key in manually monthly
   - 2 table:- OS/Stock and MPOF
3. MASTER PRODUCTION SCHEDULE
   - Based on forecast and order breaks into independent parts
4. MATERIAL ORDERING BASED ON DATA FROM STEP 2
   - Auto calculate:-
     - SAFETY STOCK
     - QUANTITY ORDER
     - PARTS ORDER
     - FOR WHEN THE PART IS ORDER
5. AUTO SHOWS LIST OF PART, QTY, FORECAST AND WHEN ORDER
6. TO KNOW WHEN THE ITEM NEED TO BE DELIVER

Figure 2. MRP system

2.3. Database used in the system

Microsoft Excel have been used and it formula, Vlookup function have been chosen to carry out this study. Vlookup is stand for Vertical lookup which is its function can ease the user who need to key in many data. For example, in this study we need to key in the data on Customer Ordering, Stock from OEM & Store and Monthly Production Ordering Forecast (MPOF) from customers. After the data have been key in, it automatically insert in the Monthly Ordering Sheet Table (MOST) (Sagbansua, 2010). Using the VlookUP, it helps to make the job more faster to be done. Without using the Vlookup, the job been more complicated and may cause error because we need to key in it one by one (manually). Besides, the job will take more time to be done (Felea and Albăstroiu, 2013).

3. Results

MOST been created to ease the ordering process at the right time, quantity and less mistake been made compare to before implementation system. As we can see, column for 'code' and 'item code' with the green color is only need one time key in. Its been made in other sheet and been transfer using 'VLOOKUP' formula. This can reduce our workload to make sure the item been key in correctly with so many times. At the right side column, all of them are auto calculate also with the formula. It is to ensure we do not need to check at many sheet when there is any error occur.

Here are the basic calculation on how the system ordering operate:

$$Part\ weight\ x\ Quantity\ of\ customer\ order = Total\ usage \quad (1)$$

From the total usage, we will make an addition 3% of current total usage to get the grand total.

$$Total\ usage + 3\%\ of\ rejection = Grand\ total \quad (2)$$

Next, we need to calculate the buffer stock also known as safety stock that need to be keep:

$$Buffer = \frac{Grand\ total}{Working\ days} \quad (3)$$

Furthermore, the supplier cannot tear the bag just to get exact value according to their customer. They might get loss if they did that. In company, the buffer stock been kept in 3 days amount.

$$3\ Days\ Buffer = \frac{Grand\ total}{Working\ days}\ x\ 3 \quad (4)$$

From all the Monthly Ordering Sheet Table, can be conclude that all of this data need to be consider to know what material need to be order and how much quantity of the material need to be order :

$$Stock + Outstanding\ PO\ (OSPO) - Grand\ Total - Buffer = Total\ Quantity\ Requirement \quad (5)$$

4. Discussion

In parallel with this research objective, to create new ordering calculation system for Blow Molding, it also can reduce time taken for the ordering process to complete which is it uses auto calculate system compare than before just using manual calculation system.
High rejection, additional factor, wrongly key in data and stock overflow are among the reasons why it can exceeds the limit. So, by using MOST, all the reasons can be control. On March, cause of pandemic Covid 19 also affect the material usage due to company shutdown.

The result shown that it is synchronize with the objective which is to implement monitoring material budget versus company cash flow. It can be seen that there is improvement on company cash flow activity. It is important to monitor the company's cash flow in order to know either gain profit or loss for the company on that month.

The main reason why material overflow occur is wrongly key in stock and outstanding purchase order and manually key in for stock buffer and fixed data of monthly vs customer ordering. On March, there is no data due to collection of the data only can be collect at the end of the month. On September 2019, company has merged their operation by combining the Bukit Beruntung plant with Rasa plant. Bukit Beruntung plant (Injection Molding) has used the MOST system but Rasa plant (Blow Molding) did not use it yet. Due to this situation, company's management have decided to standardized the system used in order to prevent material overflow at the storage which is material used for Injection Molding and Blow Molding is just same.

5. Conclusion

MOST has a lot of advantage for manufacturing company that have high capacity of production. By using it, cashflow for the company can be control and visualize. Furthermore, it also can reduce waste with the quantity material of needed use for machine setup already allocate. Besides, MOST also can make work more easier compare than before where ordering process been prepared by using manual. Using the formula, with only one time key in needed which can avoid mistake to occur. In addition, by using MOST, leadtime to complete the ordering process can be follow which is can be complete faster in the same way can inform the supplier the right types and quantity of material at the right time.

For the process data, list of formula that been mention in chapter 4 is used in order to calculate total quantity requirement. If the total is in positive form, it means the material unnecessary to order and if the total in negative form, it means the material need to order. Late arrival of material can affect the whole process especially in manufacturing products and then will face downtime, if the product did not reach to the customer at the right time. Avoid breakdown by plan a countermeasure to avoid downtime to the customer, any downtime happen will be charge by customer at the rate of 1-minute downtime equals to RM600.00. This will mainly affect the company's cashflow.

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LOCALIZATION OF AUTOMOTIVE PLASTIC INJECTION PARTS WITH LOCAL SUPPLIERS

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Abstract: Localization is an activity that creates opportunity for both consumers or end users, and to local suppliers or manufacturers. It creates a new business opportunity for the local suppliers or manufacturers, especially if the product or part is not commonly manufactured locally and needed to be imported. Although it is a common supplier, the customer company needs to ensure that the parts being produced and delivered must meet the standard requirements that is fixed. The objective of this paper is to complete the fabrication of plastic injection mould and checking fixture, achieve above 95% Off-Tool Sample for all 7 parts, and finally to reduce cost and save time. The process starts from selecting and finalizing supplier from Value Analysis/Value Engineering (VAVE), dispatching relevant data and drawings, then series of Supplier Parts Tracking Team (SPTT) Audits, and lastly Logistics and Packaging analysis. Finally, the conclusion of this paper is all the mould and checking fixture has been fabricated, Off-Tool Sample for all parts has been achieved and both cost and time has been successfully reduced more than 10%. Localization just not creates high profits, but also increases their possibilities to expand their business. For consumers or end users, it is one way for them to cut down cost and time to import those parts.

Keywords: *Localization, Off-Tool Sample, Supplier Parts Tracking Team, Mold and Fixtures*

1. Introduction

Procurement Engineers oversea the purchasing of technical goods and services for an industrial operation (Abhijeet, 2018). They have a very detailed knowledge and information of their equipment, materials, and their suppliers that being used and identify the companies that sells them. Another job aspect of procurement engineer is to evaluate their existing suppliers while adopting new suppliers. It is also to negotiate the purchase agreements and maintaining the inventory of supplies.

It is not possible for every project that Company T implement goes straight for fully localization. The projected volumes for an auto component parts should justify the investment for the supplier and the company itself. Technological challenge and quality are the main concern in localization concerns. If a car maker uses certain quality of components which are not available in the local makers, they tend to keep some amount of components to be imported to keep the quality of the automobile high and large amount of the components are localized to keep the overall cost of automobile low and competitive. It is also important that the local suppliers can produce the highest-level quality of parts that meets the standards being set with the oversea suppliers.

1.1. Problem Statement

Localizing is a process to eliminate the purchasing of parts or services from an overseas supplier and procuring from the nearest suppliers in the local area. The main concern of localizing is to minimize the costing involved to procure parts from oversea, and to reduce the time taken for the parts being delivered. For many years, Supplier NT (oversea supplier) has been supplying injection moulding parts to Company T, such as cover spare switch hole, clips, cowl side fender seal, and door dust proof seal.

To cut cost and save time, Company T took an initiative step to localize these parts to Supplier NM (local supplier), which is situated nearby to the company. Few steps and process involved to ensure not just matter of time and cost, but quality of the parts must meet the Standard Requirement (SR) of Company T to successfully implement localization to Supplier NM.

2. Literature Review

To execute this project, it is important to know the reason on localization of a service or product. We need to identify the standards and procedure of selecting a supplier, evaluating, and ensuring the supplier can meet the International Standards Requirements. The challenge in this project is about the time to fully identify the potential, ability and ensure the parts and process provided by the suppliers meets those requirements, in which most of the problem factors are man and method itself. Thus, conduction research to gather information on and the related topic is vital. The sources of the literature review are extracted from journals, article, website, department SOP and knowledge sharing from department seniors and supervisors.

2.1. What is localization?

Localization is the adaption of an industries (also related in other fields such as language, culture, or a population desires) product or services provided by local industries into their business. It can strongly show that a finished goods is a successfully localized service or product has been developed within the local culture itself. Industries going global are upending the way localization supply chains are managed (Abhijeet, 2018). They need to do localization at higher speeds and volume, in which to intensify as the world demands more. Qualifying, on boarding, training, and assigning the right resources at the right time is no small feat. The ways in which supply chain managers build, classify, and assign their resource pools will be key in the future of localization.

i. More resource transparency
ii. Increased demand for new types of resources
iii. Requirement for fast, on-demand resourcing
iv. Continuously improve

2.2. Supplier Parts Tracking Team (SPTT)

For Procurement Parts Engineering Team (PE), they need to conduct a Supplier Parts Tracking Team (SPTT) Audit/Meeting Activity whenever there is a new project of improvement/upgrade project (Kwan et al., 2019). The activity is essential to ensure parts that being procured by local suppliers meets the Standard Requirement (SR) and suppliers can deliver the parts continuously and consistently. The team will start with SPTT Kick-off

Meeting, where to officially inform the project master schedule and its requirement to all concern parties especially to supplier project members. It is also the communication platform between company and supplier management on the expectation of production preparation related issues.

After conducting kick-off meeting, both supplier and engineers will conduct a SPTT-1 to agree tooling and production preparation plans for the parts to be supplied for a new project. It usually takes place after Supplier production drawing or *Request for Design and Development* Parts (RDDP) release and *Tooling Order/Letter of Intent* (TO/LOI) is issued. SPTT-1 is the first series of SPTT meetings that are needed to be held throughout the production preparation stage for a part. Next, SPTT-2 is conducted between supplier and engineers to confirm the quality of the *Off-Tool parts* (R&D Learning Promotion Dept, 2016). The supplier must produce the parts according to SR by confirming parts *Engineering Change Instruction* (ECI) implementation status, *Off-Tool Sample* (OTS) parts against drawing and CAD data.

After that, engineers from supplier company will conduct SPTT-3 meeting, which is to confirm quality of suppliers for *Low Volume Production Trial* (LVPT) parts which will be supplied to supplier's first production trial (*1st Goshi* [1G] trial at supplier production plant). The engineers hold responsibilities to check the progress of production preparation and countermeasures (mass-production process flow, facilities, process readiness, evaluation result). Finally, engineers will conduct an SPTT-4 audit to determine the supplier production line capacity (cycle time and line loading) and stability (reject rate & process repeatability "error prevention / poka-yoke") running in High Volume production. SPTT-4 takes place before the supplier's *Mass Production Trial* (MPT).

2.3. Injection Moulding for Automotive Parts

Injection moulding is one of the most used production for plastics. Consistency, safety, and quality are the outmost importance aspects in automotive industries for injection moulding. In early days, the entire car is made up of metal, which were heavy and difficult. Slowly in 1940's where use of polymer begins to erupt in the market. And in the early 2000's, the plastic structural component was introduced and becomes the dominant production methods (David, 2007).

The injection moulding starts from a molten plastic material is injected into a mould cavity, and the plastic then cools and hardens, and removed from the mould cavity. Though the mould design process is critical and challenging, injection moulding itself is reliable method for producing solid plastic parts with high quality finish. The advantage of injection moulding is that it has high repeatability to consistently produce identical parts, highly scalable process whose overall cost decreases as the more parts are made, and high precision and surface finish quality which is essential for automotive parts.

In the automotive sector, injection moulding is one of the predominant methods used for forming plastics parts. Under the hood of a car, some of the parts are made by metals has been transitioned to plastics (David, 2007). Parts such as cylinder head covers, and oil pad are produced by injection moulding. For exterior parts, it includes fenders, grilles, bumpers door

panels and more. This protects the car from road debris and minimize splashing. Where else for the interior, instrument components, dashboard faceplates, door handles, air vents and decorative elements are made by injection moulding.

2.4. Checking Fixture (CF)

Checking fixture, or inspection fixture is the tools used to make a quality inspection for a part or product (Paul, 2019). A highly skilled person is required to make this CF because its way more complex than a shape of the part or product. CF is used to locate and hold the part with a 3D surface area. This ensures the quality and tolerance are checked, which is useful to monitor the quality issue, which is mostly needed in automotive industry. Besides that, CF serve the purpose to verify geometric feature, dimension, and tolerance according to the design specification. It defines the accurate of design dimension, surface geometry and correct position of the surface. The CF should also be easy to use, reliability, low cost, and simple construction service. Its main important aspects in a CF is the specific element needed to check the size according to design specification, the parts are produced in standard shape and size, and high accuracy of the final product.

Generally, there are 2 types of CF available in automotive industries manufacturing, which are gauging fixtures and measuring fixtures. Gauging fixture is used to inspect a part against of standard size, whether the part will pass through the fixtures follows the standard part. If the part is too large or small, it will not fit into the fixture. It is using concept "GO" and "NO-GO". In the other hand, measuring fixture is used to ensure that how much the part will be detected out of tolerance. The part will be located on the centre of the fixtures, and locator will be used to ensure that the datum and tolerance at higher inspect. The CF consist of gauging fixture, locating, clamping, and mounted elements in the body.

2.5. Value Analysis / Value Engineering (VA/VE)

Value Analysis (VA) is a process of improvising and cut cost on an existing product using problem solving system implemented with specific set of techniques, knowledge and skills (R&D, 2016). Where else, Value Engineering (VE) is mostly concerned with new products or services, which is mostly applied during development. It is an organized creative approach which purpose the efficient identification of unnecessary cost. That cost neither provides quality or usage, life, appearance, and features. When applied to products, this approach assists in the orderly utilization of better approaches, alternative materials, newer processes, and abilities of specified suppliers. But when applied to services, the approach assists in more precise determination of "what are we trying to do?"

The system identifies and deals with the factors that cause contributing cost or effort in products, process, or services, and potential localizing products or services that are currently imported and can be planned in the local area. It uses all existing technologies and knowledge to efficiently identify costs or efforts that do not contribute to the customer's needs and wants. The VA/VE problem solving system contains four different types of thinking, those are;

i. Information and assumption searching
ii. Analysis
iii. Creative thinking
iv. Judgement thinking (minimize disadvantage, maximize advantage)

3. Methodology

In this localizing project, it involves many steps that has been standardize by Company T and Headquarters at Thailand (Thai-HQ). The standard process starts with Value Analysis Value Engineering (VAVE) proposal for localization request, issuance of Engineering Change Instructions (ECI) together with 2-Dimensional drawing (2D) and 3-Dimensional Computer Aided Drawing Data (3D CAD Data), and surrounding data if required Checking Fixtures (CF). After all the data has been dispatched, suppliers will study the data and will begin the tooling progression of injection mould and CF. Once done, they will trial run the process and perform required testing and evaluation on the parts that has been produced, which is mandatorily required by Thai-HQ.

3.1. Parts to be Localized

For this localization project, there are 7 parts to be localized to supplier NM, which are;

i. Clip
ii. Cover, Spare Switch Hole
iii. Retainer, Outside Moulding
iv. Seal, Door Dust Proof (1)
v. Seal, Door Dust Proof (2)
vi. Seal, FR Fender to Cowl Side, RH
vii. Seal, FR Fender to Cowl Side, LH

3.2. Fabrication Process for Injection Mould and Checking Fixture

i. VA Proposal Request

The process of localization begins with Value Analysis (VA) proposal from Company T. Procurement Buyer (PS) will fill-in the VA proposal, as they will study on the selection of supplier, supplier's capability, costing differences between overseas supplier and local suppliers, time required for tooling of injection moulding and parts production, and sustainability of the selected supplier to ensure they can perform at their best level for a prolonged time.

ii. VA Engineering Change Instruction (ECI) and Data Dispatch

After the approval of VA from Thai-HQ to localize the selected parts to Supplier NM, the PIC from Thai-HQ designers will issue out Engineering Change Instructions (ECI) to both Supplier NT and Supplier NM. Along with the ECI, the 2D drawing and 3D CAD data that has been given by Thai-HQ designers will be issued in the system.

iii. Supplier Parts Tracking Team (SPTT) Audit – Pre-SPTT and SPTT-1

After all the required data has been dispatched to the supplier and they study on the required development process, Supplier NM will set a Pre-SPTT event. Pre-SPTT is a short informal meeting where the supplier will acknowledge to Company T's PE about their capability for the new part development, how much of time do they required, and what are the kinds of equipment, tooling and raw materials do they need to produce this part

After conducting Pre-SPTT event, SPTT-1 event will be conducted. During this event, representative of Procurement Engineers, Quality Engineers, and Logistics Engineers from

both company and supplier will attend this event. SPTT-1 is usually for PE, QE and LE to know and understand what process, lead time, tools, data and equipment needed during the fabrication of mould until the part trial sample. Supplier can revise again these documents, but they should acknowledge to company on the changes. Upon all the verified conformation, company will issue out "Tooling-GO" notice to officially start the tooling fabrication process.

3.3. Parts Off-Tool Sample

After all the fabrication of tools, mould, checking fixture is done, and the trial run to produce the part sample, supplier will inform to company's PE on the success rate and the accuracy of the part achieved. Mostly for 1st trial (T0 is done at mould maker, T1 and thereafter at supplier) the parts that has been produced has low accuracy, such as flashing, flow lines, or wrapping issues. The supplier will send back to mould maker for countermeasure the problems. This will normally take a week, then will be tested again. The part that produced must meet the SR that is mentioned in the drawing and must meet above 95% accuracy. After the parts have been measures in terms of weight, dimensions, force test, and other relevant test that is mentioned in SR is achieved Off-Tool Sample (OTS) 95% accuracy, supplier will now have to fill up all the required documents with the latest updates before conducting SPTT-2.

i. Supplier Parts Tracking Team (SPTT) Audit – SPTT-2

The main purpose of SPTT-2 is to confirm the Off-Tool Sample (OTS) parts against drawing and CAD data, and the ECI implementation status. Both Procurement Engineering (PE) and Quality Engineering (QE) need to perform various checking and inspection to ensure all the parts fully comply with SR requirement. All quality requirement documents must be completed, then a SPTT-2 Audit date will be set accordingly.

During the SPTT-2 Audit, supplier will present the documents to company for crosscheck all the documentation is correct before proceeding to parts checking. During part checking, QE will crosscheck all the parts against documentation, with the help of measuring tools of checking fixture (if required) to ensure whatever has been declared by supplier are correctly documented. LE also will check their palletizing and logistics planning, although their proposal and planning are the same (carry over from common palletizing and logistics) or new proposal. LE plays important role to ensure parts are sent without damages and the packaging can be recycled and environmentally friendly.

3.4. Logistics and Palletizing Plan

Logistics Engineering (LE) team from both Company T and Supplier NM will plan for the proper method to deliver the parts to production warehouse. Since current parts from Supplier NT is being delivered by Multi Supply Parts (MSP) and changing to Local Supply Parts (LSP), they need to plan on how each different part needed to be delivered by using long life reusable packaging system.

Each poly-box, trays, and racks are build using recycle-able items, long lasting and maintenance free material. In this way, it's possible to cut down unwanted expenses on repairing or buying new boxes or trays in the future. LE also plans and calculates the timing required for company production floor to plan when Supplier NM needs to deliver the parts,

which is using Just-In-Time concept (JIT). From here it is possible to calculate the difference timing between MSP routing and LSP routing.

4. Results and Discussion

To achieve the objective of this project, the localization project is kicked-off by dispatching all relevant documents to supplier and start the tooling progression of injection moulding and checking fixture. Once done with the tooling, the parts data and testing results are collected and ensure gain above 95% OTS results and passed SPTT activity. Finally, the value of cost and time reduction is gained.

4.1. Completion of Tool Fabrication

Supplier NM have completed all the tooling of injection mould for all the 7 parts and checking fixture for selected parts. It roughly takes 2-3 months to complete the mould and CF fabrication. Once the mould maker completes the mould, the 1st trial run (T0) is either run by the mould maker or the supplier themselves. During this time, any problem found on the mould or injected parts will be identified and the mould will be resent for repairing. Problem on the injection parts such as flow marks, flashing, and on the mould such as ejector problem or parameter settings will be identified and countermeasures that needed to be taken. Multiple adjustments and trial runs will be conducted to achieve part accuracy above 95%. The part accuracy includes dimensions, part weight, markings, colour, and appearances.

Supplier NM have also completed the tooling for checking fixture based on the given tooling surrounding data. The checking fixture will then be used to perform fitting and gap checking of the injected parts. Once all trial run and both injection mould and checking fixture is working perfectly, the parts accuracy will be measured. The project milestone has been achieved although delayed in certain activity due to multiple trial run to maximum achieve accuracy results.

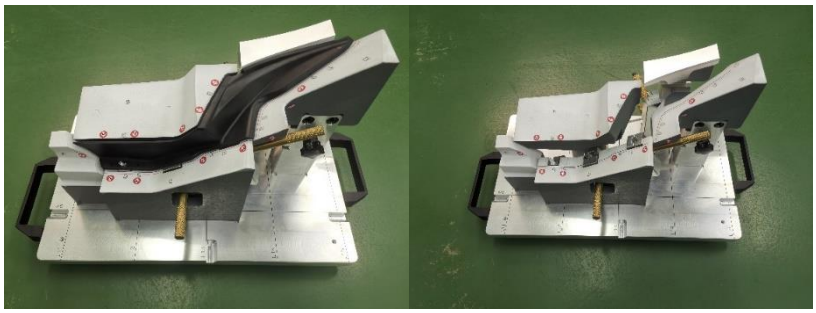

Figure 1. Checking Fixture for Seal, FR Fender to Cowl Side, RH/LH

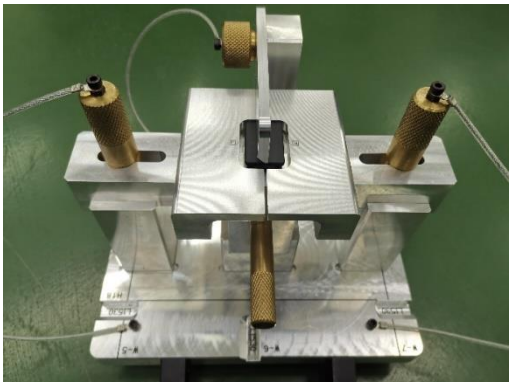

Figure 2. Checking Fixture for Cover, Spare Switch Hole

4.2. Parts Off-Tool Sample (OTS)

After the parts that have been injected and the measurements are completed, QE team will perform the parts measurement and visual checking, and data will be recorded. The points for measurement, part weight, appearances, and marking location can be found in the 2D drawing. Other required testing such as flammability, smell test, colour aging, and durability test will be conducted either by the supplier or by Thai-HQ if required. Parts performance testing will be done using together with other parts combined or assembled, and then sent for Local Parts Evaluation (LPE) to Thai-HQ. As for this localization project, all the testing and measurement has been completed and all the parts accuracy has been achieved more than 95%. Parts sent for LPE has completed performance testing and the test has been completed.

Figure 3. Seal, FR Fender to Cowl Side, RH/LH

Figure 4. Cover, Spare Switch Hole and Clip

Figure 5. Seal, Door Dust Proof (1) and Retainer, Outside Moulding

Figure 6. Seal, Door Dust Proof (2)

4.3. Calculation for Cost and Time

Cost and time are one of the important factors in this localization project. For costing, the calculation is not just based on materials, but consideration on logistics and packaging. When procuring parts from overseas, the currency exchange rates, packaging and delivery charges, and logistics plus warehousing expenses are calculated together. This causes the parts to be slightly more expensive than its original price.

Commonly for parts that are from overseas or Multi-Supply Parts (MSP) will usually take up 3~4 days (roughly 85 hours). This includes supplier producing parts, packaging, delivery and receiving at docks, then delivering to plant warehouse and sorting. Different parts from various suppliers will be packed and send at the same time, which requires time to sort the and placed in the specific warehousing location. For Local-Supply Parts (LSP), the process is very fast, efficient, and cost savings too. LSP are delivered to warehouse in milk-run system. They use reusable packaging such as trays and poly-boxes that are specially designed to ensure no damages on parts and easy to handle. Company T adopts Just-In-Time (JIT) system, where during final 10 vehicles is being out, information will be sent to suppliers on details such as parts needed to be delivered and its quantity.

Table 1. Overall Summary for Project Progress

No	Part Name	Fabrication Of		Off-Tool Sample (OTS) Results	Cost Reduction	Time Reduction
		Injection Mould	Checking Fixture			
1	Cover, Spare Switch Hole	✓	✓	100%	12.5%	67%
2	Retainer, Outside Moulding	✓	N/R	100%	16.4%	67%
3	Clip	✓	N/R	100%	13.9%	67%
4	Seal, Door Dust Proof (1)	✓	N/R	100%	15.0%	67%
5	Seal, Door Dust Proof (2)	✓	N/R	100%	14.6%	67%
6	Seal, FR Fender to Cowl Side, RH	✓	✓	100%	20.0%	67%
7	Seal, FR Fender to Cowl Side, LH	✓	✓	100%	18.8%	67%

5. Conclusion

Localization is a process where all the tools, equipment, and materials are obtained or produced locally. In which means the raw material, machines and additional components parts is owned or purchased locally. Supplier NM had successfully fabricated and produced plastic injection mould and checking fixture by the help of local mould makers and precision tool makers. The mould and checking fixture have a lifespan of more than 5 years, and basically the model life of a specific variant vehicle is also around 5 years. This gives more benefits for the suppliers and continuous business to customers. Plus, since the design of the parts are common for all vehicle variant and future design vehicle, this gives more benefits for both customers and suppliers.

Upon completion the fabrication of mould and checking fixture, the parts Off-Tool Sample (OTS) has been produced and achieved accuracy above 95%. With that achievement, the parts produced by Supplier NM has comply to the standard requirement of Standard Requirement (SR), in terms of material quality and performance, parts dimension and physical appearance. Finally, more than RM63,000 of costing by this localization has been saved, and around 57 hours of time has been shortened for parts being produced and transported from Supplier NT.

5.1. Recommendation

There are still various parts and equipment's that can be localized not just in automotive sector, but also for various other sectors. This creates big opportunities for business expansion, investment, employment, and profits for the local industries. Localization must be done with controlled conditions to ensure the quality and performance of the localized parts or equipment's are always at the best quality.

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DEVELOPING MANPOWER ARRANGEMENT USING WORK MEASUREMENT IN FT AND LH PACKING + WEIGHING LINE

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Abstract: This project is to study the work measurement and manpower arrangement of Company AD. Company AD is a food processing industry, where the main business is poultry processing. In this study, it has been identified Company AD's one of the departments (EVI) is facing poor manpower arrangement, delay in production and absenteeism due to tiredness from previous day overtime working hours. To overcome this issue, it is necessary to measure the manpower productivity using work measurement and arrange the manpower accordingly. Stopwatch used to measure the workers' performance in this project, where the workers' productivity will be taken 2 times per day for 3 weeks. The data that been collected will be analyse and 2 workers will be chosen for each work so the desired outputs of the study are work measurement and manpower arrangement. This change in manpower arrangement reduce the overtime working hours.

***Keywords**: work measurement, manpower arrangement*

1. Introduction

Work measurement is all about the measurement of time and also output of an activity. Work measurement allows doing changes and manpower arrangement as well. Work measurement can be classified into 2 types. One is according to standardization and another one is according to past records and performance. In this study, past records and performance will be use. Other than that, as work measurement involved with the measurement of time it is also referred to as 'Time Study' and also 'Productivity Test'. Measuring time and output is very important to do any effective work plan (manpower arrangement schedule). To find out the suitable productivity time for a product, time examine is carried out.

1.1 Problem Statement

There is problem in Evisceration department regarding manpower arrangement. Due to poor manpower arrangement, it is unable to achieve the targeted productivity level. Daily production ends up later than targeted time when the production work actually can be completed within targeted time frame. Next, the management also intended to minimize the overtime works as most of the workers tend to be absent due to excessive tiredness (sick) and presenteeism from previous day of overtime work so they prohibit workers from doing overtime unnecessarily. Unnecessary work time or overtime work happened due to poor manpower arrangement and it affects the production process for the following day.

This project is focuses on:

i. Work measurement to get the productivity data; and
ii. Manpower arrangement to solve the productivity problem.

1.2. Project Objective

The objectives of this project are:

i. To get productivity data to compare the performance of workers.
ii. To analyze the productivity data using work measurement to identify and place workers according to their performance.
iii. To reduce the overtime working hours of worker with the use of effective work measurement and manpower arrangement.

1.3. Scope

The scope of work in this project is:

i. Focuses on two activities, FT Packing + Weighing and LH Packing + Weighing to get the productivity data using work measurement.
ii. Focuses on productivity data to develop manpower arrangement .

2. Literature Review

2.1. Work Measurement

Work measurement is about determining the time taken to complete a job by a worker. Mostly this work measurement is conducted to identify the productivity level or capability of a worker in completing the job in a specific time frame. This is a beneficial study method used by a lot of management to determine the performance and productivity of an individual worker. The basis for conducting work measurement is (Kjell, 2003):

i. To accomplish planning; or
ii. To determine performance; and
iii. To establish costs.

2.2. Stopwatch study

After the way of work is find out, the time study should be taken. The time measurement should be done to know the time taken to do the job. Many companies have their way of time study. There is equipment to use in measuring the time of a job. One of them is the stopwatch (Jain et al., 2016).

Below is the procedure for doing a stopwatch study:

i. Work procedure should be found out.
ii. The time required to do the job should find out.
iii. Work should be recorded using time machines (stopwatch).
iv. Time should be recorded by the supervisor or person in charge.
v. Recorded data later should be used for analysis.

2.3. Manpower arrangement

Manpower arrangement (planning) is planning a right capable worker and the right amount of worker to use at the right place and right time by line leader or supervisor. No conscious in both private and government sector towards this manpower planning to their own benefits. Manpower planning should be taken into consideration. Poor manpower planning always leads to a bad process flow. Manpower planning is highly needed in the achievement of an organization (Kareem, 2012).

2.4. Manpower planning

Planning is known as what should be done or implemented for a better future time frame and to achieve the goals that have been set", told Unugbro. Planning is an advanced step that determines whom and when should be a job done. Manpower should be skillful to better growth. This manpower planning is done due to avoid any manpower shortage that results in the poor output. Planning also needed much because it results in better use of human resources (Igbokwe-ibeto, 2015).

2.5. Absenteeism and Over time theory

Based on Thompson's view, absenteeism is happened due to the extended hours of work. Workers tend to be absent in order to relieve the fatigue caused by the extended hours of work. The rate of absenteeism is known with any certainty, the management has to plan their manpower accordingly and avoid the extended hours of working. Firms might be hiring standby workers to tackle absenteeism, yet absentee rates are so dynamic in nature and it is hard for companies always to have enough number of replacements available at all the time. Thompson also found that extended hours of works must be done by the existing employees in order to meet the production schedule (Kimmo et al., 2012).

2.6. Effective Manpower Management

Worker's requirement can be measured using work measurement for production and it can change as required for worker efficiency. If there is no work measurement, then the worker's planning will be done using the existing plan level. The manpower planning should be done by the engineer and manager as well. They are responsible to choose the workers responsibly using work measurement. This manpower management has focused on many types of research. An effective manpower management results when changes occur according to requirements (Simon, 2014).

3. Methodology

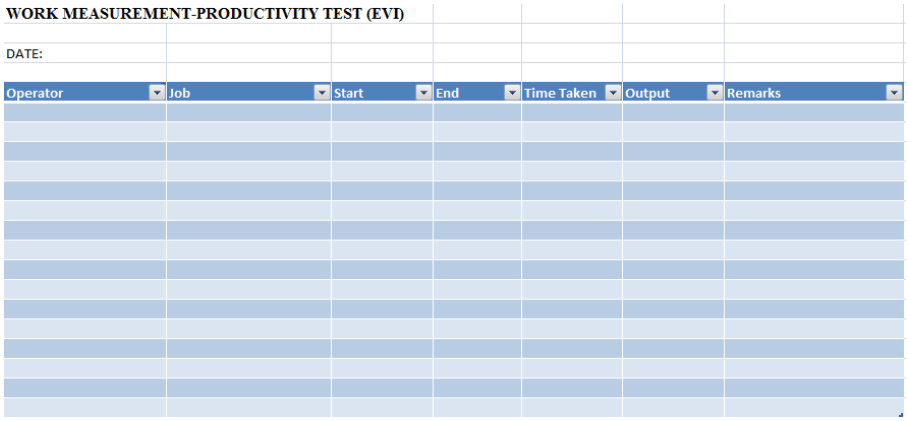
3.1 Stopwatch time study

Stopwatch time study is the work estimation to decide the benchmark for future improvement as shown in Figure 1. It is likewise used to dissect a particular procedure by qualified laborers with an end goal to locate the most productive routes as far as time. Besides, this technique gauges the time important for a work procedure to be finished utilizing the most ideal ways. The time was estimated utilizing snapback stopwatch hardware since it is simpler and quicker in information recording. Besides, this kind of stopwatch is appropriate for this exploration since it can create exact information. This permits the component times to be entered straightforwardly on the time study sheet without the requirement for subtractions.

Figure 1. Stopwatch used for collect productivity data

3.2. Data Collection Method

Data collection is the main part of this project before analyzing data. Each and every data contribute to this project is tabulated in Figure 2. In this project, the data called productivity data. This productivity data comes under work measurement. This productivity data collected 2 times per day. This data collection process took almost 4 weeks. 1 week of trial data and 3 weeks of exact data. Trial data were taken to confirm whether the data collection is done in which way and time. Data collection in this project did using the stopwatch. Before data collection a table was created to fill up it using productivity data. The table contains the worker's name, type of job, time is taken (min) and output (packs) column. The focus should be there when taking the reading of a worker. For this project the output of workers set to 20 packages. But, it differentiates in working time. So, the stopwatch shouldn't be a pause or stop meanwhile 20 packages were packed.


WORK MEASUREMENT-PRODUCTIVITY TEST (EVI)

DATE:

Operator	Job	Start	End	Time Taken	Output	Remarks

Figure 2. Work measurement template used.

3.3. Microsoft Excel

For doing data key in analyzation, I have chosen Microsoft Excel. Microsoft Excel is a worksheet invented by Microsoft for Windows, macOS, Android and iOS. In excel there is graphing tool, tables and calculations. Microsoft Excel developed in 1993 and use widely by people around the world. In this project, I've chosen Microsoft Excel to create graph for the data collected. In this project, I've create a table in Microsoft Excel. Then, the collected work measurement (productivity) data were key in the table. Later, the data were used to create bar and line (combined graph) graph to show the data analyzation.

3.4. Data Analyze (Bar and Line Graph)

Bar and line graph used in this project to differentiate the workers performance, so that an effective manpower arrangement can be developed. There are steps followed to create bar graph.

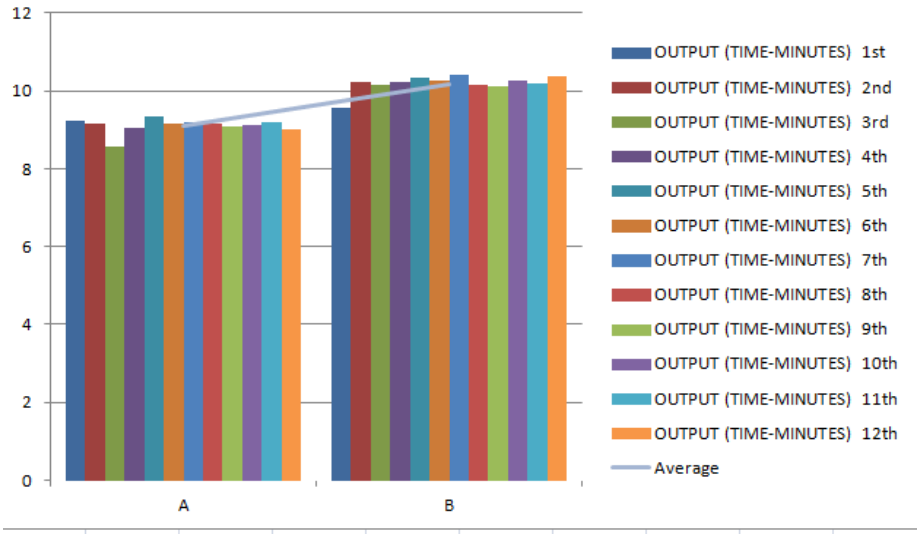


Figure 3. Bar graph made in this project.

Figure 3 shows the X-axis indicates the workers and Y-axis indicates the time taken for workers to complete their job. The workers studied in this project were given same task to get a correct work measurement data. Using this bar graph, we clearly can know the performance of workers as it makes easy to place them for better output.

3.5. Brainstorming

A group of people whom, production engineer, supervisor, line leader, and trainee discuss to fix well perform worker in each and every activity for better productivity. Focusing on one of the department in Company AD and brainstorming done to fix the way of the place the workers in each and every activity. The discussion ends up in a way where work measurement chosen to measure the worker's performance to develop the manpower arrangement schedule. The tool used in a brainstorming session is mind maps. In this mind map, the results of the discussion will be draw.

3.6. P-D-S-A Cycle

In this project, Plan Do Act Study (PDSA) was used as one of the problem-solving tools. This PDSA cycle used to do the project wisely. This PDSA cycle has 4 phases which are, Plan, Do, Study, Act where each of the phase guide this project to do successfully. In the Plan phase, the process of the job was studied. Later, process flow was created to follow the flow. The project was planned and the type of measurement was chosen, "work measurement". In the Do phase, work measurement was done. Each and every data for work measurement was key in. Productivity data for the chosen worker was recorded for 3 weeks continuously. In the Study phase, the work measurement data was studied and analyzed. The graph was created using Microsoft Excel to analyze the productivity data measured using work measurement.In the Act phase, the analyzed data will be used to create an develop manpower arrangement for better productivity output and reduce overtime working hours.

4. RESULT AND DISCUSSION

4.1. Example of data before implementation

Table 1. Example of work measurement data before implementation

OPERATOR	OUTPUT (TIME-MINUTES)												Average	TOTAL PACKS	REMARK
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th			
A	9.03	8.56	10	9.25	8.35	9.02	8.52	9.05	9.00	9.22	9.08	10.02	9.09	20	
B	11.04	11.12	11	12	11.52	11.32	12.3	13.1	11.42	12.36	11.48	13.04	11.81		
C	11.58	13.02	12.34	13.28	12.5	12.2	13.05	12.11	12.00	13.30	12.58	12.36	12.53		
D	10.52	10.34	9.58	10.2	10	10.42	10.25	10.06	10.15	10.32	10.22	10.18	10.19		
E	15.58	16.02	16.23	16.05	16.18	15.46	16.33	16.24	16.12	16.05	16.14	16.05	16.04		
F	17.32	17.48	18.04	18.12	18.23	17.56	18.04	18.26	18.15	18.23	17.58	18.02	17.92		

Table 1 shows data collected 2 times per day for 6 days in a week. 6 workers been measured before arrange them accordingly. The measurement was done to find out the 2 workers whom suitable for the work that plotted in Figure 4.

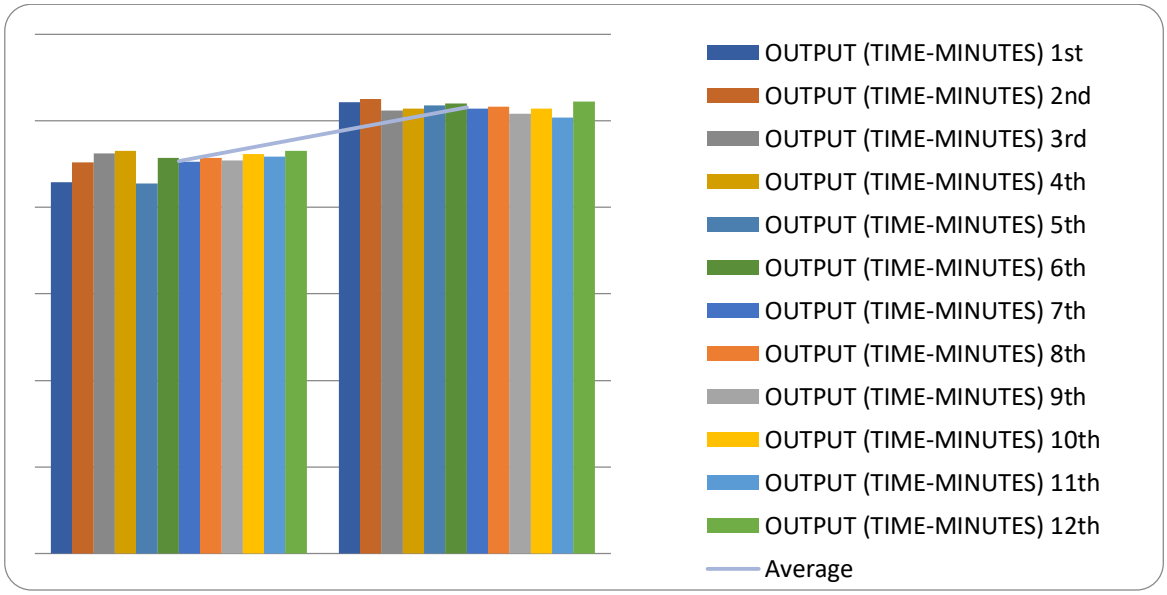


Figure 4. The combined bar and line graph shows work measurement of workers for before implementation

4.2. Example of data after implementation

Table 2. Example of work measurement data after implementation

OPERATOR	OUTPUT (TIME-MINUTES)												Average	TOTAL PACKS	REMARK
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th			
A	8.58	9.04	9.24	9.31	8.55	9.14	9.06	9.15	9.08	9.23	9.18	9.30	9.07	20	
D	10.43	10.5	10.24	10.28	10.36	10.4	10.28	10.33	10.17	10.29	10.08	10.45	10.32		

Table 2 shows data collected 2 times per day for 6 days in a week. This work measurement done after 2 suitable workers chosen from the 6 worker. The data taken to prove the 2 workers are suitable for the work as plotted in Figure 5.

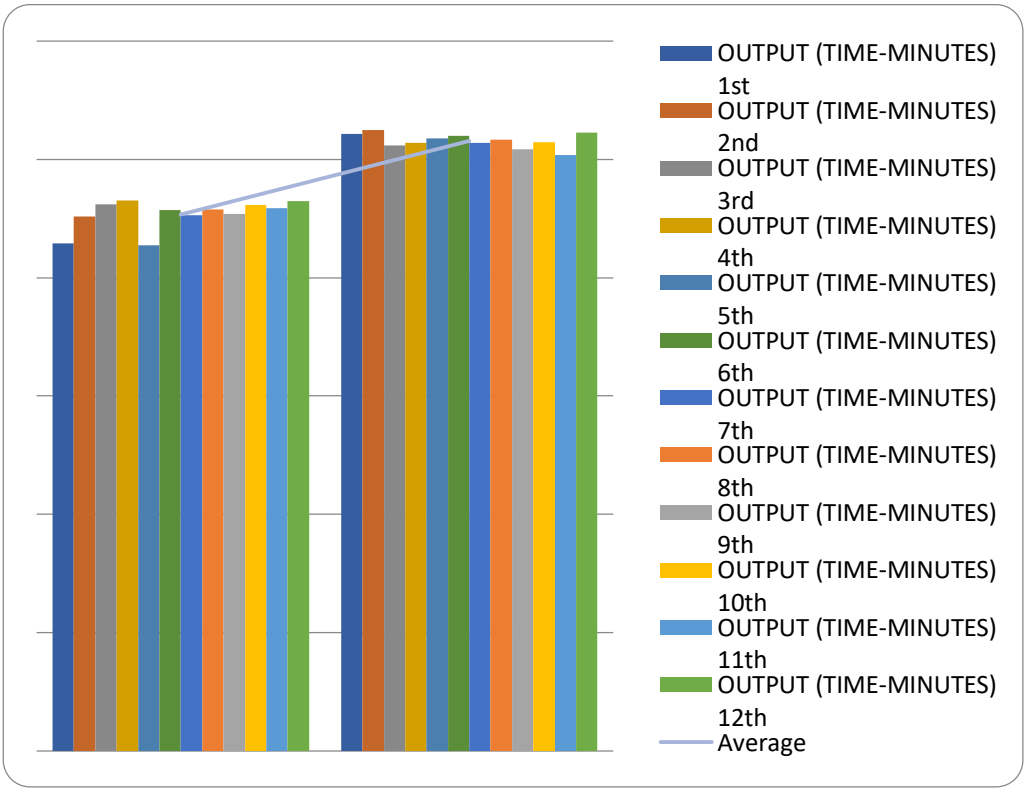


Figure 5. The combined bar and line graph shows work measurement of workers for after implementation

4.3. Working hours and overtime hours of before implementation

Table 3. Data of working hours and overtime hours of before implementation

OPERATOR	WORKING TIME	OVERTIME HOURS
A	144	73
D	144	94.5
TOTAL	288	167.5

Table 3 shows the chosen 2 workers normal working hours and overtime hours of the 3 weeks (before implementation). This data was collected to analyse the reduction of working overtime hours. The calculation as refer to Equation 1.

Calculation:

$$\text{Formula:} \quad \frac{\sum OT}{\sum(WT+OT)} \times 100\% \qquad (1)$$

$$\frac{167.5}{455.5} \times 100\% = 36.77\% \approx 37\%$$

The above calculation was done to find out the overtime hour percentage (before implementation). This overtime percentage was calculated to find the reduction percentage of working overtime later in the project as conclusion.

4.4. Working hours and overtime hours of before implementation

Table 4. Data of working hours and overtime hours of after implementation

OPERATOR	WORKING TIME	OVERTIME HOURS
A	144	51
D	144	64
TOTAL	288	105

Table 4 shows the chosen 2 workers normal working hours and overtime hours of the 3 weeks (after implementation). This data was collected to analyse the reduction of working overtime hours.

Calculation:

$$\text{Formula:} \quad \frac{\sum OT}{\sum(WT+OT)} \times 100\% \qquad (1)$$

$$\frac{105}{393} \times 100\% = 26.71\% \approx 27\%$$

The above calculation was done to find out the overtime hour percentage (after implementation). This overtime percentage was calculated to find the reduction percentage of working overtime later in the project as conclusion.

4.5. Result and Discussion

The result of this project will be the difference in percentage (%) of worker's overtime hours. In this project 6 workers are been measured and 2 of them were chosen for each activity. So, in this project 4 of them been chosen and measured again to find out the difference of overtime hours, respectively. Each worker has their own speciality and this project is for measure people performance and placed them in the suitable work.

Result Calculation (Percentage drop after implementation)

i. To find out the reduction in overtime working hours (%):-
Before percentage – After percen (1)

$$37\% - 27\% = 10\%$$

ii. To find out the reduction in overtime working hours (%):-
Before percentage – After percentage

$$36\% - 25\% = 11\%$$

This results shows the reduction in percentage of overtime working hours. The percentage has reduce 10% to 11%. As I mentioned earlier in this project correct placement of workers in the job can reduce overtime working hours.

5. Conclusion

Work measurement is biggest engineering tool where it helps more in manpower arrangement. In this project work measurement was used to gets the productivity data to compare the workers performance, to develop the manpower arrangement schedule and also to reduce the overtime working hours. In this case, the objective achieved where the overtime hours has reduced 10% and 11%. As I mentioned before manpower planning are in 2 types. One is short term manpower planning and another one is long term manpower planning. In this project, the concept of short term manpower planning was used to measure the workers performance and placed them in right place. According to this arrangement, the worker will finish their job earlier than the wrong placed worker before this. So, this will be result in reduction of overtime working hours. So, this project has bring an advantage to the company.

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DEVELOPING AND ESTABLISHING WORK INSTRUCTION FOR MACHINE SETTINGS & ADJUSTMENT

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Abstract **-** The aim of this study is to establish a new work instruction with an effective procedure of machine settings and adjustment for production department of a company. The machines in the new plant need regular settings and adjustment to run smoothly. Lack of machines adjustment cause the production itself to exceed product wastage. The method used for analysis was survey questionnaire and swot analysis. Comparison was done by using before and after implementation product wastage data. The outcome of the study will be establishment and implementation of new work instruction.

Keywords*: Work Instruction, machine settings & adjustments*

1. Introduction

A work instruction is a set of step-by-step instructions produced by assembling information collected by an organization to help employees to carry out multiple operations. They distribute the procedure into a human-focused method of working that allows the specialist on the floor to finish the job on hand. An effective work instruction is important because they ensure the successful performance of a procedure as long as the processes. They also include clear and precise information to carry out a job in a safe and efficient way that conforms to all relevant manufacturing standards. These instructions aim to achieve quality output and consistency of performance. Work instruction also may help in reducing mistakes and failure to comply with industry regulations.

1.1 Problem statement

The management was made their way to build a new plant in 2017 and successfully finished in 2019. Finally, the new food production plant was started to operate in November 2019. Most of the process that has been done manually in old plant was replaced with advanced technology which is machinery in new plant. Even though a machine was replaced, there are still several adjustment needed regularly for the machine itself to function well. At the same time, lack of work instruction for the machine adjustment will affect the organization to achieve its target. Lack of work instruction for machine also increases the wastage during production especially at AMF-BX Line. AMF-BX Line function to process breast cap and fillet products effectively. There are wastage found in high quantity. It is because the machines is not adjusted and maintained well as stated in the manual as it succeed failure. There were also machine breakdown for several times due to improper adjustment made before starting the line. Improper settings and lack of adjustment towards the machine is the main cause for the above situation.

1.2 Objectives

The purpose of doing work instruction is:
1. To establish work instruction especially for machine settings and adjustments.
2. To minimize product wastage by implementing work instruction.

1.3 Scope/ Limitation of study

Main scope of this project is to establish a work instruction with enough information for production department use. Besides that, this work instruction only covers machine settings and adjustments for production department use. This work instruction is specially created for AMF-BX line of the production. This project will result to minimize the AMF-BX line product wastage.

2. Literature Review

2.1. Definition of work instruction

The definition of work instruction based on the American Psychological Association (APA) is a "description of the specific tasks and activities within an organization" (APA, 2019). A work instruction in business will generally outline all of the different jobs needed for the operation of the firm in great detail and is a key element to running a business smoothly".

2.2. Principle of work instruction

According to Blaga's point of view work instruction can be illustrated as an important source used to indicate the ways of performing work together with a procedure (Boer and Blaga, 2012). Work instruction should be in detailed form as it meets the main scope. They are analyzed in terms of their preciseness, suitability, and structure before approved by the company's head of the department and the general manager. Work instruction is encouraged to be done by the person who is involved in those particular processes. This should be done based on selected documents and is valid within that particular department that runs the regulation process. The instruction is established according to the type of work, its location, and its environment. The employer in charge that particular process should ensure the condition for each employee acquires sufficient and proper training on the form of information and instruction especially to their workplace.

2.3. Elements in developing flow chart for the processes

Beluško found the first step used to develop a flow chart is the definition of station and operation followed by definition of worker and workers, product or parts and tools used (Boer and Blaga, 2014). Header and footer are created in the template to make the workers easy to find the information. It also helps in raising the worker's attention toward the important information written. These elements stay at the top or bottom of the page so it would make the worker and team leader to have a concentration on the important information written. To increase the attention of the workers for additional information such as the created date and creator information are written in the footer. After finish adding the essential information into the header and footer, pictures of the product tools are added. The pictures created should be placed in the angle workers see them as they can reveal multiple sides. It is

necessary to place the pictures of the part and tools at the right side of the picture, it would create understanding among the workers.

2.4 Type of work instructions

a) Photographic instruction
According to Boer, a decision was made to use photographic material as an alternative method by transferring information from the existing work instruction. The new form of visual type instruction aims to illustrate the job that has to be done by the employee. The illustration of the instruction will be in short and simple, in the case to form understanding among the employees. Visual type instruction will highlight the comparison of what is expected to be done, versus what is not expected to be done or what is not with a picture guide.
b) Traditional instruction work instruction vs the photographic work instruction
Based on Boer, comparison between traditional instruction and the new photographic ways of presenting instruction was made by taking the needed time by the employee to present, assimilate and process the information. The result shows 50% of the time has been reduced by the new photographic ways of presenting method.

2.5 Survey Questionnaire study

Questionnaires are defined as content based instrument used to approach the participant to series of answer the question or respond to a statement to either by indicating a response. Usually it is created by rating a page, writing a number or checking a box on paper or online. Besides that, a survey or questionnaire with relative questions and answers can eliminate structured individual interviews as it can reduce time taken and save cost. It also has become the most common- used research tools in the social sciences. Questionnaires have become one of the method used by less experienced researchers to value their experiments or studies. The reason of researchers choosing questionnaires as it is easy to construct, they are portable or can be made available online. Moreover, the data they gather can be analysed effectively compared to spoken data which has to be recorded and transcribed before analysis.

3. Methodology

3.1. Brainstorming

Brainstorming help in identifying the problems and chances for improvement of the processes in establishing new work instruction at the company. Brainstorming is also used as a method for generate ideas to solve several problem that would occur while developing the work instruction. A mind map has been created to discuss about establishing new work instruction at first before plan a project. A work instruction will contain the information related to the machine settings and adjustment of the production department of DPP company. In the production department, there are five lines previously at the old plant. There are four major lines at the new plant operated by machines for most of the process when compared to the old plant. Therefore, this work instruction is different from the old work instruction.

3.2. Content format in work instruction

Subject
- The tittle of that particular section or description of the processes involved.

Purpose
- Be as specific as you need to be to define the purpose of the document.

Equipment
- List all unique tools required to perform tasks as indicated in this work instruction.

Reference
- Reference upward to the procedures that the work instruction is controlled by and reference forms by control number used to create records.

Instructions
- List all steps to be taken to complete the scope of this work instruction, in the exact sequence necessary.

3.3. SWOT Analysis

Figure 1. SWOT anaysis

Figure 1 shwos the swot analysis for this research project for more understanding of the job scopes.

3.4. Questionnaire survey study

A questionnaire is a set of questions that is responded by giving opinions towards any research or innovations. The questionnaire also means a lot in collecting quantitative data. It enables quantitative data to be collected and used for analyzation. Besides that, there should be a purpose of creating a questionnaire and it should be related to the objectives of the research. It is also a method used to collect information from a large number of people, known as respondents. A questionnaire that constructed effectively is critical to the success of a survey. Creating a questionnaire with suitable questions, appropriate scaling or with correct format will make the survey complete, because it represent the respondents views as well as their opinion. A tool used to review a questionnaire to ensure that the intended information is correctly collected is to pre-test with a smaller group of target respondents (Lundgren et al., 2008).

4. Result & Discussion

4.1. Data collection

Result and data was recorded for 2 months then discussed in two parts separately. Firstly, wastage quantity before and after implementation was collected. Secondly, the wastage data is used to compare and discussed well. Thirdly, a survey of questionnaire with related question about the work instruction is prepared then handed to the production department experts. This is mainly done to have their personal opinion about the new work instruction. Besides that, the comparison has been made using total product wastage data of before and after implementation. It is purposely done to have the percentage of total product wastage found in a week from its overall total production. Data collection that has been made starting from January 2020 until February 2020 was used to come out with a line graph.

Table 1. Overall product wastage data for January 2020.

January 2020	Week 1	Week 2	Week 3	Week 4
Total Product Production (Kg)	210080	231208	251100	205458
Product Wastage (Kg)	2821.7	3124.4	2591.2	2958
Product Wastage (%)	1.34%	1.35%	1.03%	1.44%

The product wastage data in AMF-BX line was successfully collected before establishing new work instruction. This data proved the need of regular adjustment towards machine. This data was collected on January for 4 weeks. Week one shows total of 2821.7 kg wasted product. Followed by 2nd week, whereby, 3124.4 kg of wasted product was collected. This data stated an increase of total product wastage in 2nd week. Next, 2591.2 kg of wasted product were collected in 3rd week. This shows decline of wasted product in 3rd week. Besides that, 2958 kg of wasted product was collected on the 4th week. This data shows an increase of product wastage compare to 3rd week data. The overall data of January shows an inconsistency. These data was converted to percentage form to study its effects towards the overall success of production process in processing the product. These data show more than 1% of wasted product is being collected in a week as tabulated in Table 1.

Table 2. Overall product wastage data for February 2020

February 2020	Week 1	Week 2	Week 3	Week 4
Total Product Production (Kg)	212300	214500	219110	215000
Product Wastage (Kg)	1683.3	1674.6	1729.7	1970.4
Total Product Wastage (%)	0.79%	0.78%	0.79%	0.92

It seems a drastic change in the amount of product wastage as it creates improvement. The technician puts effort to do the adjustment everyday to get the actual data of product wastage. The data in above table shows the data collected after implementation of the written work instruction for production department use. In the data, it seems the quantity of wasted product reduces as not went above 2000 kg compare to before implementation data. Wasted product collected for 1st week was 1683.3kg. Followed by 2nd week of 1674 kg. Both data shows a little difference. on the 3rd week the wasted product increases to 1729.7kg. Besides, again an increases to 1970.4 kg of wasted product on the 4th week. These data stated that work instruction really help in reducing wastage of product in the production department. If the adjustment and settings is done everyday, the chances of machine breakdown is low as well as product wastage. The collected data was converted to percentage form. The percentage data again proves that less than 1% of wasted product is found to be rejected by the machine as tabulated in Table 2.

Table 3. Comparison of before and after implementation wastage data

Product Wastage	Week 1	Week 2	Week 3	Week 4
Product Wastage In Jan 2020 (Kg)	2821.7	3124.4	2591.2	2958
Product Wastage In Feb 2020 (Kg)	1683.3	1674.6	1729.7	1970.4

In addition, both before and after wastage data was compared mainly to come out with a result. The comparison result shows up to 1000 kg of wasted product is being reduced weekly. The Figure 3 below clearly explained the difference between January and February wastages. On the 1st week of January, the wastage rose to 2821.7 kg and it dropped to 1613.3 kg in February. Almost 1138.4 kg of product has been saved due to proper adjustment before run the machine. On the 2nd week of January, the damaged product found was 3124.4 kg as it decreases to 1674.6 kg in February. Difference of 1449.8 kg found in 2nd week. On the 3rd week of January, 2591.2 kg of wasted product was found and it decreases to 1729.7 kg in February. For the last week of January, the wastage found was 2958 kg as it dropped to 1970.4 kg in February. We can conclude that, product wastage found in AMF-BX line are reducing in February 2020. It is because in February the technician managed to do machine settings and adjustment almost 4 days in a week as depicted in Figure 2.

Figure 2. Settings and adjustment done by the production technician at AMF-BX line

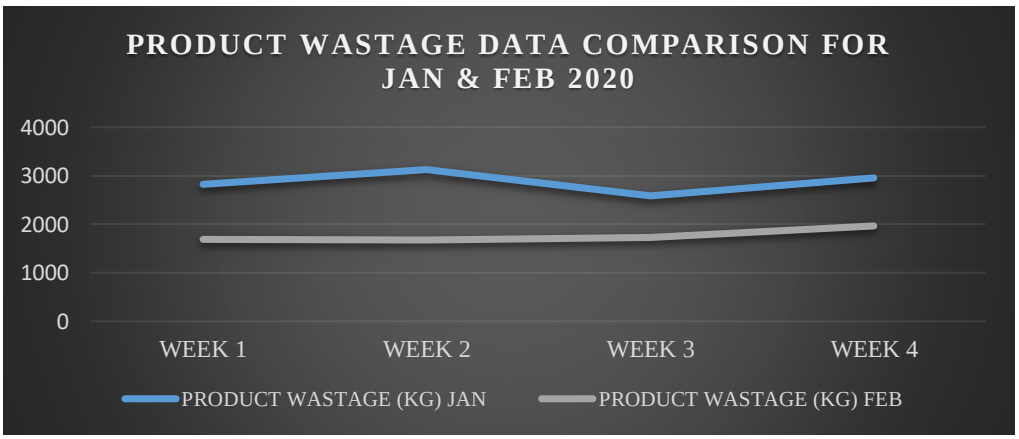

Figure 3. The effectiveness of the new work instruction to do changes towards the overall production of product in AMF-BX line.

Lack of setting and adjustment can impact the whole machine to succeed interior part damages in short period of time. The work instruction is created by using machine module's specific name as it can make the users to identify easily.

4.2. SWOT Analysis discussion

Swot analysis is used as a method to obtain the strength, weakness, opportunity and treats. It really helps this project to build a strategic plan to meet goals and improve operation. During implementation it is necessary to do analysis about the proposed swot analysis.

Strength

Lack of work instruction for machine adjustment lead the technician not to do maintenance until a breakdown occurs. Not only breakdown, lack of work instruction cause too much of wasted product found. Sometimes, the technician will try to do adjustment without any procedures and instruction. They used to do the adjustment with their own knowledge. It considered to be wrong that can increase the risk level. Because when the adjustment went wrong, it would affect the organizational to face high amount of product wastage. So creating work instruction with relevant information of the machines eliminates the risk as it maximize the product. Besides that, product wastages has become one of the problem succeed by the production department. The reason of product wastages was lack of machine adjustment. This

problem cause machine to process the chicken with damages. Not only that, lack of machine adjustment causes machine breakdowns. The adjustment should be done before the machine started to run almost every day. By doing this the machine will run smoothly without problem.

Weakness

The weakness of work instruction is when the technician or general operators failed to understand the language and terminologies used. Most of the workers in the company are foreign workers. They might not able to understand the language used in the work instruction. During implementation, it seems all of them are good in reading and understanding the instruction while doing the job effectively. Besides that, the workers might misunderstood and misinterpret the content. This problem can cause them fail to complete a job. Misunderstand can take place when they only focused on the picture without reading the steps. Because the pictures are illustrated to make the workers easy to identify machine interior structure. It seems the workers able to understand the language used so that they can avoid from being misunderstand.

Opportunity

The production department will feel better if the production increases. Almost more than 1% of wasted products are found in the production in a week. This situation will directly effects the organization to sustain or increase its productivity. So when the adjustment takes place, it reduces to less than 1% of product wastages. From this result, it is advisable to the whole organization to keep doing adjustment before run the machine to avoid product wastage. Secondly, when the number of breakdown reduces, it can minimize the production delay. Sometimes, the breakdown took almost one hour as it effects the whole production department to succeed production delay. Foreign workers becomes one of the issues that can lead this project to succeed problem at the beginning. As long this issue has failed to take place. Because the foreign workers are really good in understanding the language used. They can follow the instruction and steps to accomplish the job.

4.3. Work instruction survey questionnaire

Figure 4 shows the survey to evaluate the responses and personal view towards the established new work instruction. This questionnaire consist of 15 questions with 5 answer options as shown in figure below The questions was created after 2 weeks of the implementation. It is done properly to engage the relationship between production department experts. These responses are important to have their personal advices and recommendation towards the established work instruction. Moreover, this set of questionnaire is handed to 50 production experts and workers to have their personal opinion about the new work instruction. Their answers has been rated then and been evaluated as shown in the below table.

Figure 4. Respondents filling up the questionnaire

4.4. Survey questionnaire content discussion

a) Does work instruction able to reduce the product wastage at AFM-BX line?

The answer given by 45 respondents was always and another 5 answered often. Whereby, about 90% of respondents agreed that work instruction benefits to reduce product wastage in the mentioned line.

b) Does the information is relevant with the existing manual book?

The answer given by 47 respondents was never and 3 people responded by selecting always. Whereby, 94% of respondents disagreed with the question because the existing work instruction is about manual processes of old plant compared to settings and adjustments work instruction.

c) Are the information in the work instruction is efficient in educating the workers to complete the machine adjustments?

This question strongly agreed by the respondents as all of them answered always. This question results 100% in achieving the workers understanding about the content.

d) Does the information is well relate the pictures included?

Almost 35 people answered always and the rest answered often. This result shows 70% of the respondents agreed that the photo illustration help the workers to understand the content if they refers to the pictures.

e) Are the instructions facilitate working environment?

For this question, 35 respondents has agreed for always and the rest of them choose often. This question only able to achieve 70% of the respondents to choose always.

f) Does basic safety information is included in the work instruction?

For this question only 60% of them agreed and filled always. The rest of them equally anwered often and sometimes.

g) Does the included pictures benefits in reducing time taken to complete the adjustment?

This result shows that only certain times the picture helps in reducing time besides following the instruction

h) Does work instruction reduces number of machine breakdown in the production floor?

The answer given by 76% of the experts was always and the remaining percentage of experts filled often. This result shows that work instruction able to reduce machine breakdown in the production.

i) Do you often use the work instruction to make setting and adjustment of the machine?

Almost 80% of the respondents was selected always as their answer and the remaining 20% of people selected often.

j) Does the work instruction has enough steps of the setting and adjustments?

Almost 44% of respondents selected always and the remaining 6% of them selected often. This result shows that work instruction has been understood well by the users.

k) Do the organization use the setting and adjustment to control the product wastage?

This question was included to have the organization's opinion towards new work instruction. The main objectives was discussed in the question and it can be a chance for the experts to review this project. This particular question achieved 100% of respondent to choose always.

l) Does the work instruction is being used almost 4 days in a week?

This question managed to achieve 88% of the respondents to select always and the remaining 12% of respondents selected often. This result shows that adjustment is being done more than 4 days in a week.

m) Does this adjustment benefits machines performance?

The respondents agreed by giving 100% of answer for always.

n) Are the instruction is followed by the production technician to solve machine breakdown?

The result shows 60% of the respondents selected always and the remaining 40% of the respondents selected often and sometimes equally.

o) Does work instruction is also being used for other problem solving?

The answer given by respondents was 70% for always and followed by 20% for often whereby the remaining 10% for sometimes. This result shows that work instruction has the ability to overcome some other problem in the production.

5. Conclusion

In conclusion, this project has met its success to reach the production department team. New work instruction helps in solving wastage problem in the production department. Lack of settings and adjustments is the main cause of product wastage. It is because machine's need regular inspection and proper adjustment to run effectively. The adjustment should be done almost everyday before start up the machine. High volume of wastage found at its starting period. This project is done especially to help the production department workers to do regular machine adjustment to reduce product wastage. This project has successfully reached

the proposed objectives as stated. Besides that, the scope of this project is to establish a work instruction with sufficient information as it able to educate the users and finally reach the objective to minimize the AMF-BX line wastage. This scope has been achieved as it result in minimize the wastage level in the mentioned line as well. This effort also reduces the risk of machines malfunction or sudden breakdown.

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LAYOUT DESIGN DEVELOPMENT BY USING DIRECT SUPPLY METHOD

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Abstract: The aim of this project is to study the layout design at sub – assembly instrument panel area of a company. The company is an industry for automotive products. In this study, it was found the at sub – assembly instrument panel area in the company was facing problems with achieve takt time 5.8 min per production. In order to overcome these problems, the workforce productivity was measured using work measurement method. The objectives of this study were to study the current layout design at instrument panel area, to purpose a new design layout and to optimize the utilization of the space in sub – assembly instrument panel area. Time study was used as the method for work measurement. New layout design was designed to increase the daily production in line and eliminate *muda* during handling the processes.

Keywords: *Work Measurement, Time Study, Muda*

1. Introduction

The company wants to achieve the new takt time as target setting in daily production which is 5.8 min per production after major arrangement of layout in Local Supply Parts (LSP) area. However, the company faces delays in certain area making it difficult for the company to reach its new target setting. One of these areas is sub – assembly instrument panel. The problem was distance travel by each team member was quite far and it is consuming a lot of time when still using *jundate* method. After that, increasing the touch number on the parts instrument panel upper and lower also happens during operation supply and installation because of the repetitions work by team members. The objectives of this study were to study the current layout design at instrument panel area, to purpose a new design layout and to optimize the utilization of the space in sub – assembly instrument panel area. Time study was used as the method for work measurement. Time study is one of the work measurement technique where time taken for worker to finish a task under certain condition is recorded.

2. Methodology

2.1. Time Study

Time study is used to dissect a procedure by competent workers with the aim of locating the most time-consuming productive routes. The time is usually estimated using snapback stopwatch technology because information collection is simpler, faster and used to generate accurate information. It allows the time of the part to be recorded conveniently on the timesheet without subtraction. This stopwatch method is using the speed rating. Speed rating is a tool to determine the fast and slow worker. Time study was conducted 10 times in before and after implementation.

2.2. P-D-C-A Cycle

The problem-solving method used in this study is PDCA. First, the Plan is to discuss the objectives of this project and the ways to achieve the objectives (Parissa, 2010). Time study was used for work measurement and productivity data was created for data collection and new layout design was designed. The second is Do which is implementation of new layout design for direct supply method. The third is Check which is set the time for data analysis and results obtained from after the implementation of new layout design. Lastly is Act where some changes were made to the new layout design until the it achieves the target takt time which is 5.8 min per production.

2.3. Observation

From observation, *genba* and *genchi genbutsu* method were used to investigate the problems at sub – assembly instrument panel area. Genba methods are quality circles and suggestion systems. In quality circle, a specialized team develops and design ideas concerning how to improve the company's performance (Manos, 2007). Suggestion systems encourage employees to submit suggestion for improving work process and customer satisfaction. Genchi Genbutsu as a Japanese term which mean "go and see for yourself" that practices their business. It's also used in cooperation with job rotation to make sure that they learn each task and get new information to make sure that they know all aspects of the business involves.in their assignment, they learn each task by doing it from scratch (Rene, 2013).

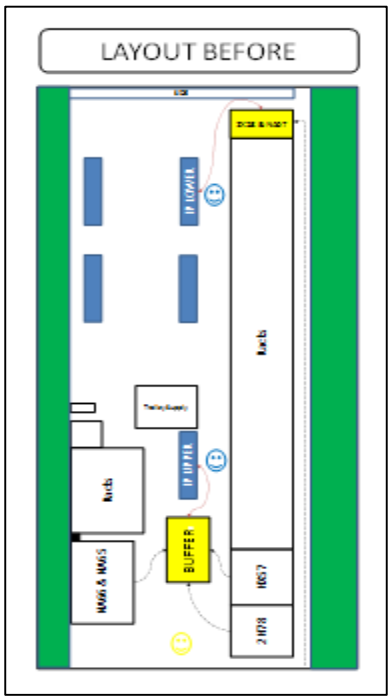

Figure 1. Layout sub - assembly instrument panel before implementation (Hashim, 2008)

Figure 1.0 shows that before implementation direct supply system, there have three team members that involve instrument panel upper and lower operation which is one team member from logistics as supply parts and two sub – assembly team members as installation. The problem was distance travel by each team member was quite far and it is consuming a lot of time. Total logistic team members need to walk for supply parts 25 meters. Total distance travels for sub – assembly team member's instrument upper and lower parts are 3.5 meters.

After that, increasing the touch number on instrument panel upper and lower also happens during operation supply and installation. This is because of the repetitions job scope by team members during handing the parts. For example, team member logistics supply instrument panel upper and lower to buffer. After that, team member sub – assembly pick up the parts for installation instrument panel upper and lower. Then, team member sub – assembly drop off to buffer when done installation and pick up again for supply to the line side. Therefore, four touch numbers detected during installation.

2.4. Data collection

The data of cycle time were determined by the work. The data collected 10 cycles time to measure team member job scope. This application applied during implementation whether before or after implementation. The stopwatch was used for data collection in this project.

3.0 Result and Discussion

The changes of supply method from *jundate* to direct supply method give more impact to current layout. Due of this method changes, new layout has been proposed. Comparison layout in sub -instrument panel area between before and after implementation show that the reduction 15.115 m^2 of space usage after implementing direct supply method. Figure 2 below show that the optimization usage of space happens in sub – assembly instrument panel area.

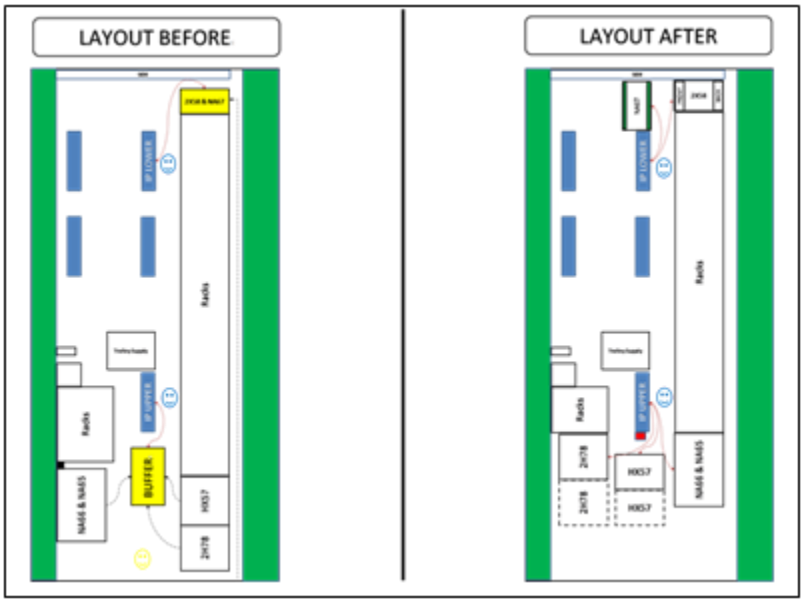

Figure 2. Comparison layout before and after implementation

As we can see the calculation of total reduction area at sub – assembly instrument panel upper and lower:

Total reduction area

= **Area before – Area after**

= 192.485m^2 – 177.37m^2

= **<u>15.115m^2</u>**

From this implementation, reduction of manpower from 3 team members involves to 2 team members as shown in Figure 2 by eliminate logistic in work element which is supply process. After that, it also reduces the distance travel by team members during handling the processes at sub – assembly instrument panel area. Team member need to take a walk only 1.8 meters from their home position and just spend 1.8 seconds in one-way travel. Compare with data before, team member needs to take a walk 3.1 meters from their home position and the time taken for the team member travel 5.8 second in one-way travel.

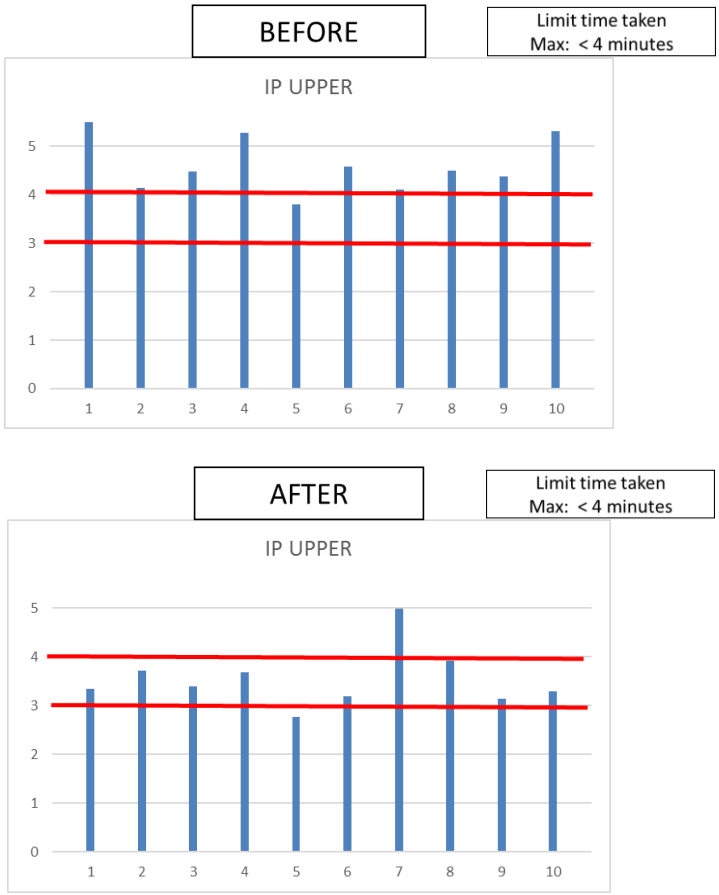

Figure 3. Comparison cycle time before and after for IP Upper

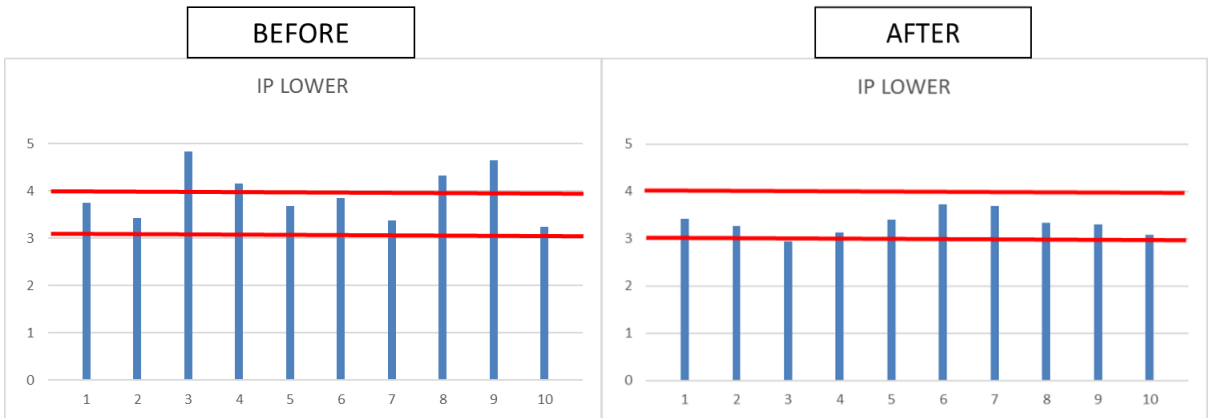

Figure 4. Comparison cycle time before and after for IP Lower

Figures 3 and 4 illustrate the graph of 10 cycles of time during Kaizen activities before and after implementing the direct supply method at sub – assembly instrument panel upper and lower with set up in acceptable ranging for implementation. To achieve takt time 5.8min per production instrument panel upper and lower need to follow the guidance ranging of cycle time for example, process assemble the instrument panel does not exceed the max level which is 4 minutes. As per figures 3.0 and 4.0 shown above, before implementation, the graph shows that data taken exceed from limit compare with after implementation. Its because of team member expand more time on travel during assemble the instrument panel upper and lower. After new layout come out, reduction of cycle time occurs and its give the advantages for implementation of direct supply method.

4. Conclusion

All the objectives of this project had been successfully achieved. According to study the layout design, waste (*muda*) detected at instrument panel area during operation and need to eliminate. For example, motion waste, time waste and space waste. With the purpose new layout design, it gives advantages for instrument panel area to changes the supply method form *jundate* to direct supply. By optimizing the space at instrument panel area, reduction cycle time and travel distance happen at instrument panel area. It also reduces overburden on team member. Implementation direct supply method at instrument panel upper and lower area gives more advantage to daily line production. Reduction cycle time and travel distance are the factors to this project as per show at the past chapter. By elimination non – value added process makes the operation smooth without have any repetition work and decrease the amount of touch point on the instrument upper and lower parts.

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CHICKEN PARTS GRADING PROCESS EVALUATION USING MEDIAN METHOD

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Abstract: Several production lines in this company are using manual process. Work measurement is conducted in order to improve the productivity of grading. The work measurement data will be used to evaluate the lead time for the current grading process, to evaluate optimum time of grading process and to compare the productivity of the grading process at previous production plant and current production plant so that the performance of each graders can be obtained, the lead time and time taken for the whole grading process also can be obtained.

Keywords: *Cutting machine, work measurement, productivity*

1. Introduction

Work measurement is the approach of coming up with the time that a task would take when the operator working on completing it at a rate of performance (IMS, 2019). The work measurement for each operator can be recorded easily by carrying out stopwatch time study (Rio and Siti, 2018). Discussing with them also helps to get to know if there is anything slowing them down while they are working. Each operator has their own capability in working (O'Hara, 2017). Some factors affecting their performance are gender, age, weight, temperature of surrounding and etc. (Julie, 2009). In this study, the section is completing a few process, from unload birds, cutting, grading, weighing, vacuum thigh, packing, registering & tagging, sort in crate & sort in pallet. The processes involved both manpower & machines to complete those tasks & produce quality products. Each process has no time standard because manpower processes influenced by a few factors. Without time standard, process completed earlier, some completed later which causes overtime but some of the processes cannot be completed even by working overtime. The processes involved manpower and machine at the section are determined & studied through this time motion study while determining an average time needed to complete each process at the department in order to improve productivity and reduce rejection rate. As shown in Figure 1 below, the whole birds are cut into parts manually by operators. Those parts are graded manually by operators where they check for reject parts which are separated according underweight, overweight, and rejected parts. Rejected parts consist of bile stain, broken and bruises. When graders mistakenly graded the parts, quality control officers will detect them when they carry out inspection every hour. The inspection includes measuring temperature, weighing each part and rejected parts. Reject parts contain bruises, bile stain and broken. Before carrying out the inspection, they make sure the weighing machine and thermometer are calibrated. Metal detector also will be inspected by placing the

metal sample on the packaging and sending them under the metal detector. The metal detector will automatically reject the packaging, stop the conveyor and show red light signal. Each of the sample tested three times to ensure the metal detector working properly.

Figure 1. The Process Flow including Grading Process

Figure 1 above shows the process flow which the chicken parts go through before and after grading process including grading process.

2. Methodology

2.1. Stopwatch Time Study

Time study using stopwatch is one of the methods used to calculate work measurement. It is a process of measuring time taken using a stopwatch for a particular operator to complete a process at a section of the department. Since the stopwatch is used for time study purpose, it must be very accurate in measurement to the precision 0.01 minute (Shivam, 2020). Measuring the time for a few times is optional to obtain effective result in order to calculate the average time taken to complete the particular work (Jain, 2019).

2.2. Data Sheet

Date : ①
Order of the day: ②

③ Time	④ Job Task/ Activity (per person)	⑤ Quantity (birds/ pcs) (5 minutes)	⑥ Time taken (per min)					⑦ Avarage for 1 min	⑧ Number of Manpower	⑨ Remarks
			1min	1min	1min	1min	1min			

Figure 2. Data Sheet Used to Record Data

Figure 2 above shows the data sheet used to record the work measurement data manually while using stopwatch.

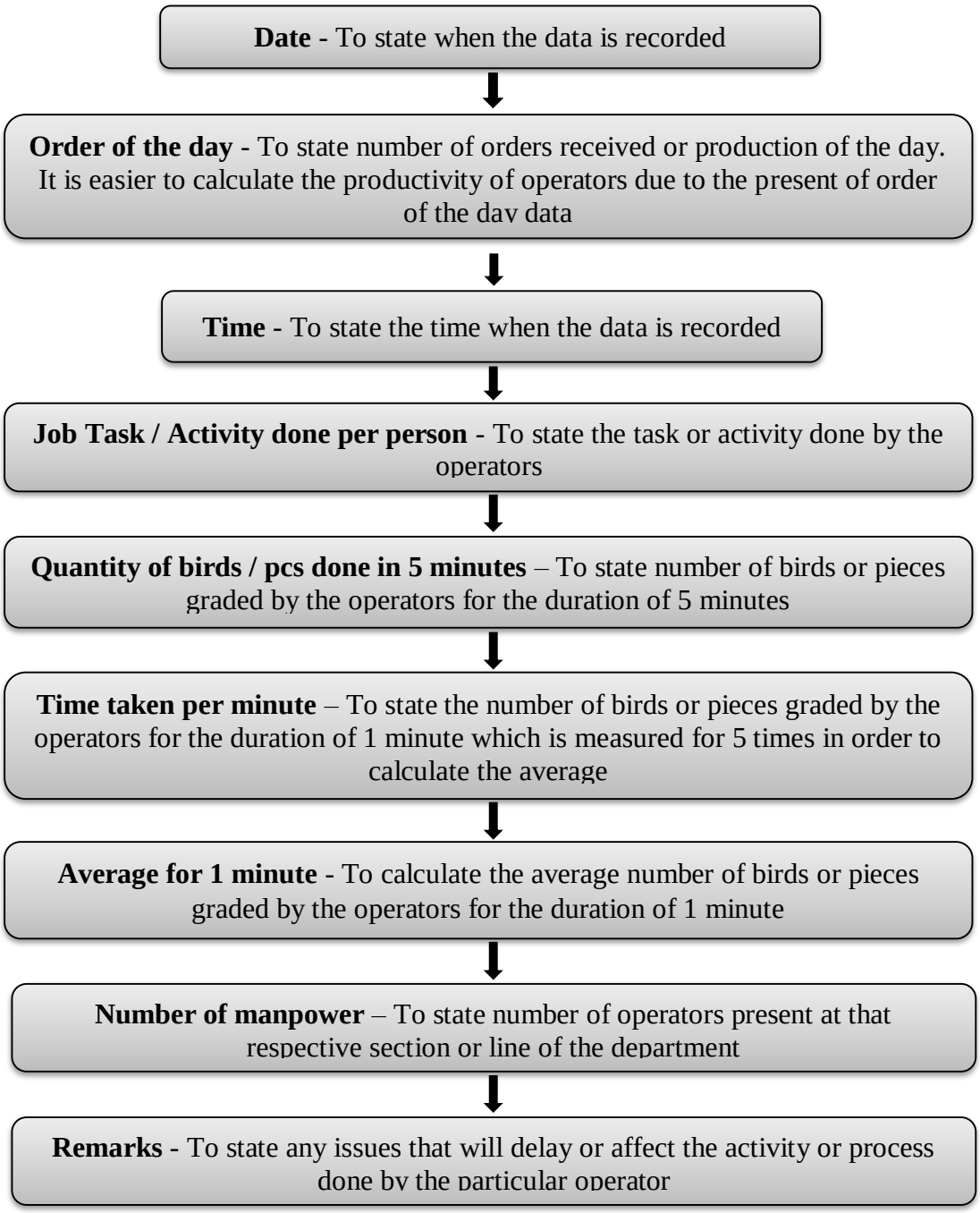

Figure 3. Flow chart of the time measurements work

Quality inspection also carry out randomly during the grading process as charted in Figure 3. Sometimes operators mistakenly cut the whole birds which is called wrong cut. When wrong cut takes place, the parts conveyed towards graders and graders will do visual inspection on the parts and reject them according to overweight parts, underweight parts and reject parts. Graders will do grading after the cutting process takes place and the parts conveyed towards them on the conveyor. They pick up those parts from conveyor, inspect them visually and put it into the top container above the conveyor for packing. If there are reject parts, they are separated according underweight, overweight, and rejected parts. Rejected parts consist of bile

stain, broken and bruises. When graders mistakenly graded the parts, quality control officers will detect them when they carry out inspection every hour.
Three crates of products are chose randomly and inspected. The inspection includes measuring temperature, weighing each part and rejected parts. Reject parts contain bruises, bile stain and broken. Before carrying out the inspection, they make sure the weighing machine and thermometer are calibrated. If they are not calibrated, they will send it to lab for calibration. Metal detector also will be inspected by placing the metal sample on the packaging and sending them under the metal detector. They metal detector will automatically reject the packaging, stop the conveyor and show red light signal. Each of the sample tested three times to ensure the metal detector working properly because it is included as one of the critical control point. This test is done to make sure the metal detector, the sensor gate which rejects packaging, the signal light and conveyor works properly.

3. Results and Discussions

There are two processes that will be explain at this section. The first process is the birds slaughtering process and the second process is the grading process. The slaughtering process using automation system increases the minimum processed bird from 7 birds per minute to 60 birds per minute

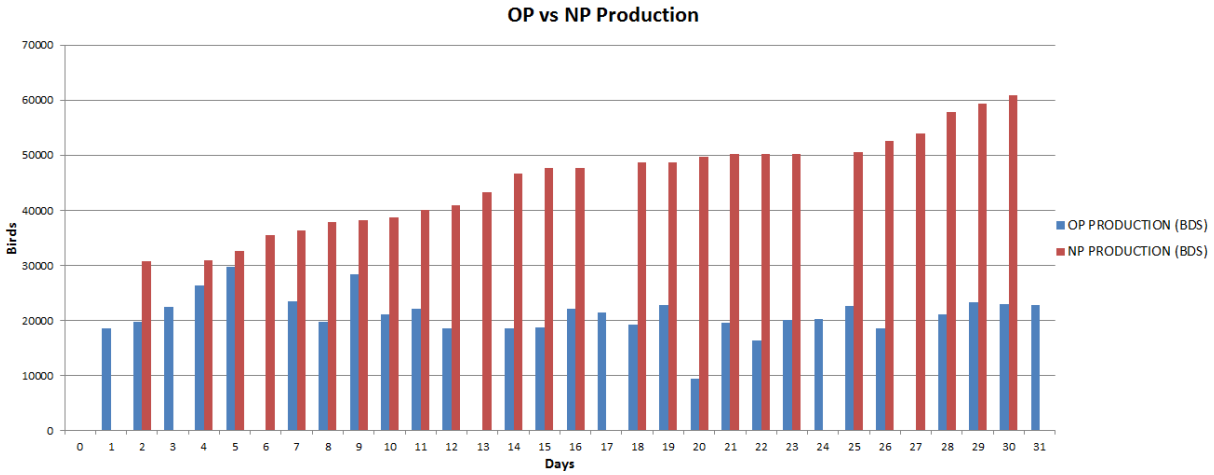

Figure 4. Old Plant versus New Plant Production Data

Figure 4 above shows the production data for M line at old plant and new plant daily. While, Figure 5 and Figure 6 shows the birds for M line at old plant and new plant by minutes and hourly. The data recorded at old plant are affected by factors such as weight of whole birds, weight of parts, wrong cut by cutters, number of operators working each day, defects on whole birds and parts such as torn skin, bruises, broken bones, broken wings, and etc. The factors related to machines won't affect the data recorded at old plant because every process done manually here. The data recorded at new plant are affected by factors such as weight of the whole birds, weight of whole bird parts, defects of cutting by machines, defects on whole birds and parts such as torn skin, bruises, broken bones, broken wings, and etc. Moreover, the data recorded at new plant was during testing while gradually increasing the number of birds processed each day because it was newly opened and some adjustments were taking place in order to make sure production runs smoothly and better than the old plant. The engineers and operators were working together while undergoing training and learning about the new

technology, system, maintenance and machines. Half of the process took place at old plant at beginning of November because of the machine cutting adjustment and weight of the parts can't be full fulfilled according to customers' demands.

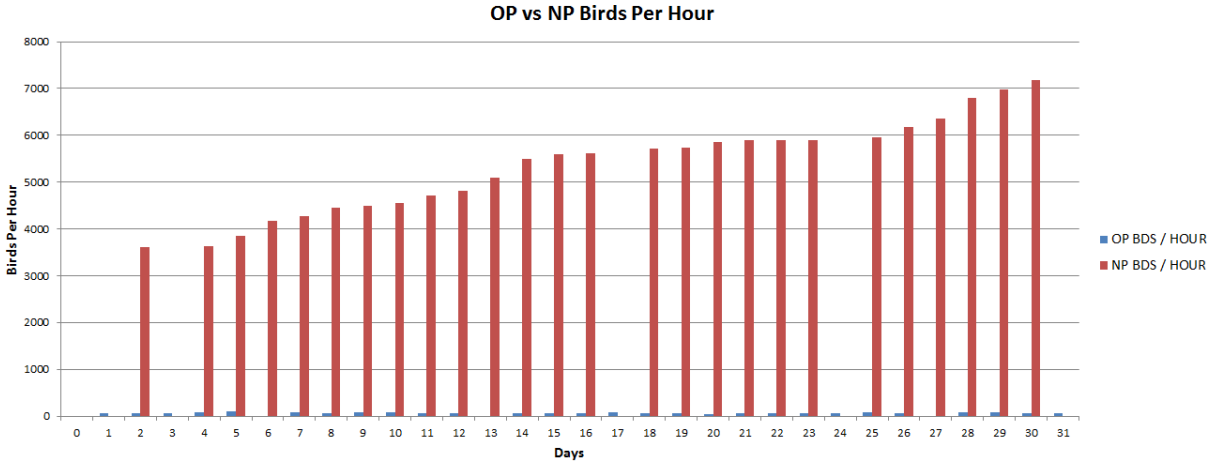

Figure 5. Old Plant versus New Plant Birds per Hour Data

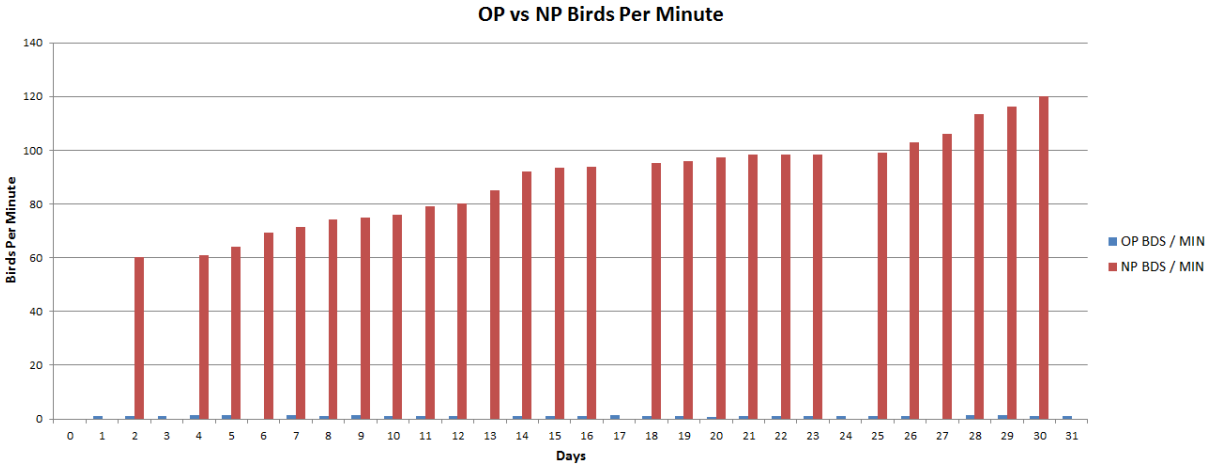

Figure 6. Old Plant versus New Plant Birds per Minute Data

However for grading process, two parts of chicken has been compared that is chicken thigh and drumstick. Figure 7 and Figure 8 show the grading comparison for M line at old plant and new plant for chicken thigh and drumstick for the month of October 2019 and January 2020. Old plant grading done manually while new plant grading done manually by operators then the graded parts put onto conveyors with sensor gates which will grade according to each weight of the parts set by supervisor of the line. The parts will be separated according to its weight range whether acceptable or reject. If the parts is too near the sensors will miss counting some of the parts which will bypass all the sensor gates and enter the crate placed at the end of the conveyors. These parts will be put onto conveyors again by the operators so that the sensor gates detect them. At old plant, grading process is slower because the whole process done manually compared to new plant which is done within 46 hours of the whole month.

The chicken thigh and drumstick that can be produced in 3 months increased by 160,000 pieces compared to old plant production.

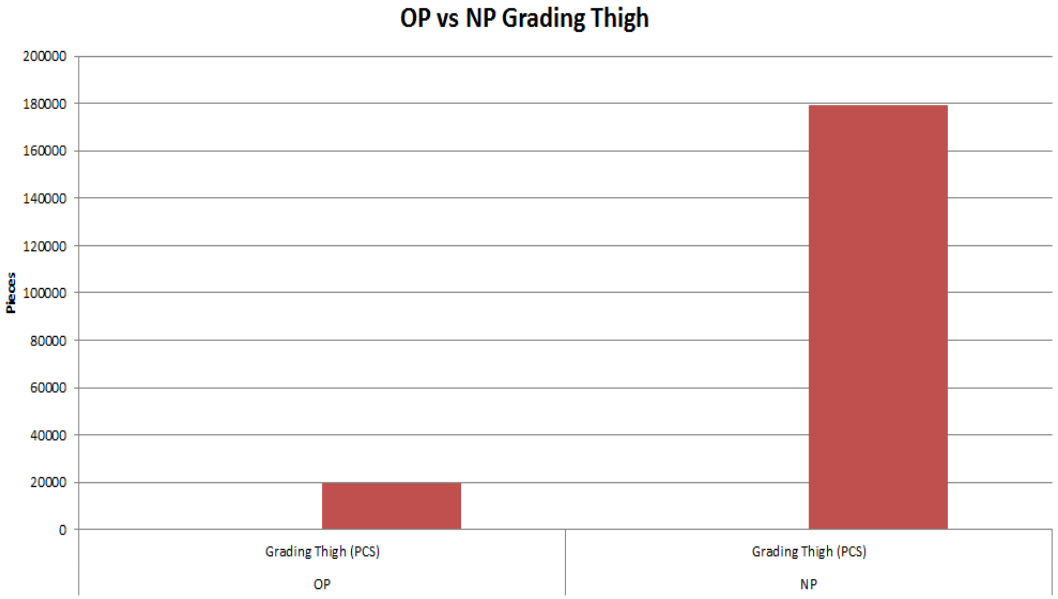

Figure 7. Old Plant versus New Plant Grading Thigh Data

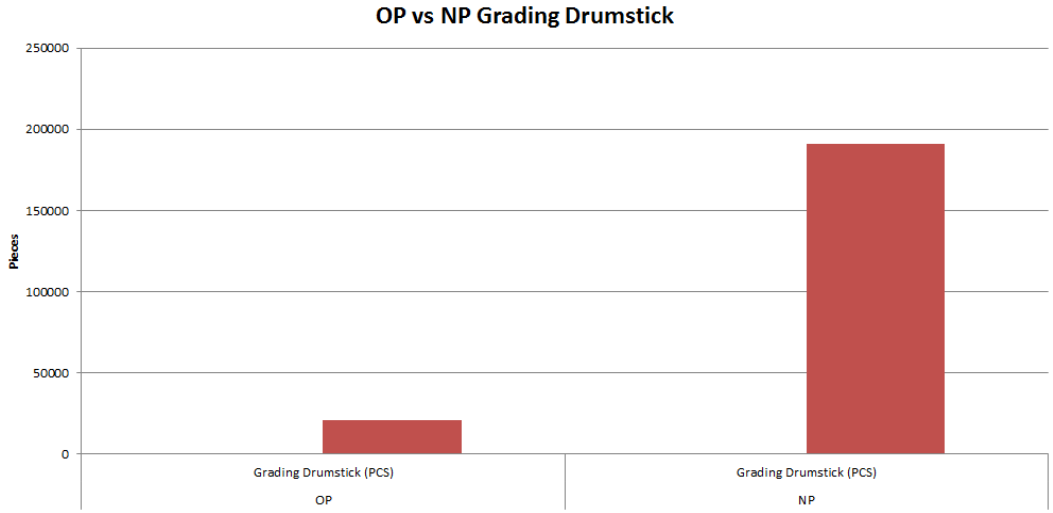

Figure 8. Old Plant versus New Plant Grading Drumstick Data

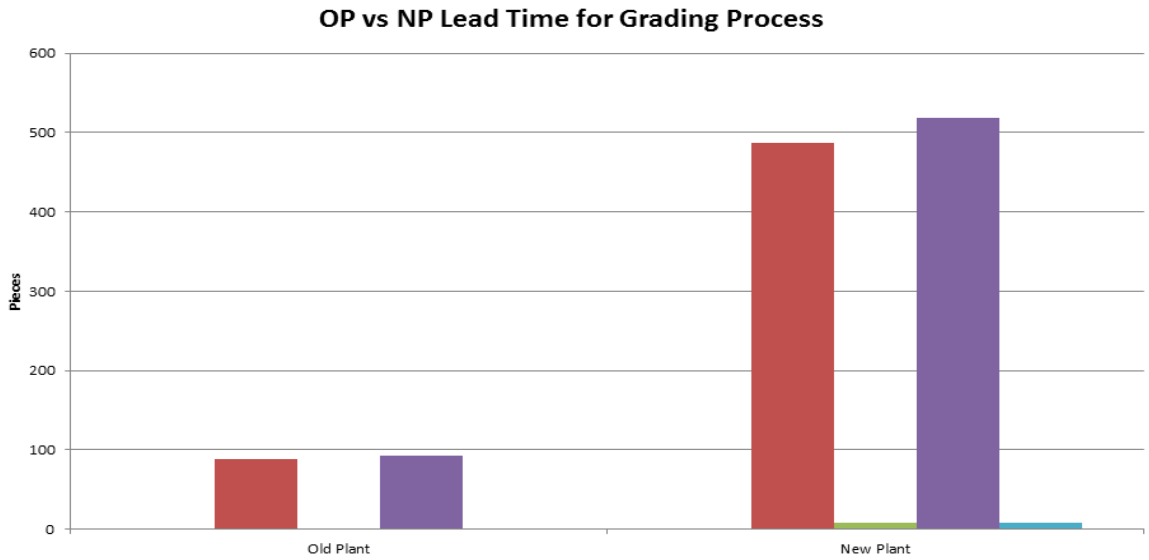

Figure 8. Old Plant versus New Plant Lead Time for Grading Process Data

Figure 8 shows the percentage of grading rate lead time for thigh parts at new plant improved by 453% compared to old plant. While the percentage of grading rate lead time for drumstick parts at new plant improved by 464% compared to old plant.

Calculation for percentage of improvement is refer to Equation 1 shown below (Rio and Siti, 2018).

$$Mean, \overline{X} = \frac{x_1 + x_2 \dots x_n}{n} \quad (1)$$

2019

Mean, $\overline{X} = \frac{19518+21095}{2} = \frac{40613}{2} = 20306.5$

2020

Mean, $\overline{X} =$

$$\frac{191028 + 179137 + 169569 + 186957 + 193043 + 235509 + 188824 + 198163 + 210222 + 236345 + 236265 + 219494}{12}$$

$= \frac{2444556}{12} = 203713$

Percentage of improvement $= \frac{203713 - 20306.5}{20306.5} = \frac{183406.5}{20306.5} = 903\%$

The calculation above shows percentage of increment of grading process productivity rate for new plant by 903%.

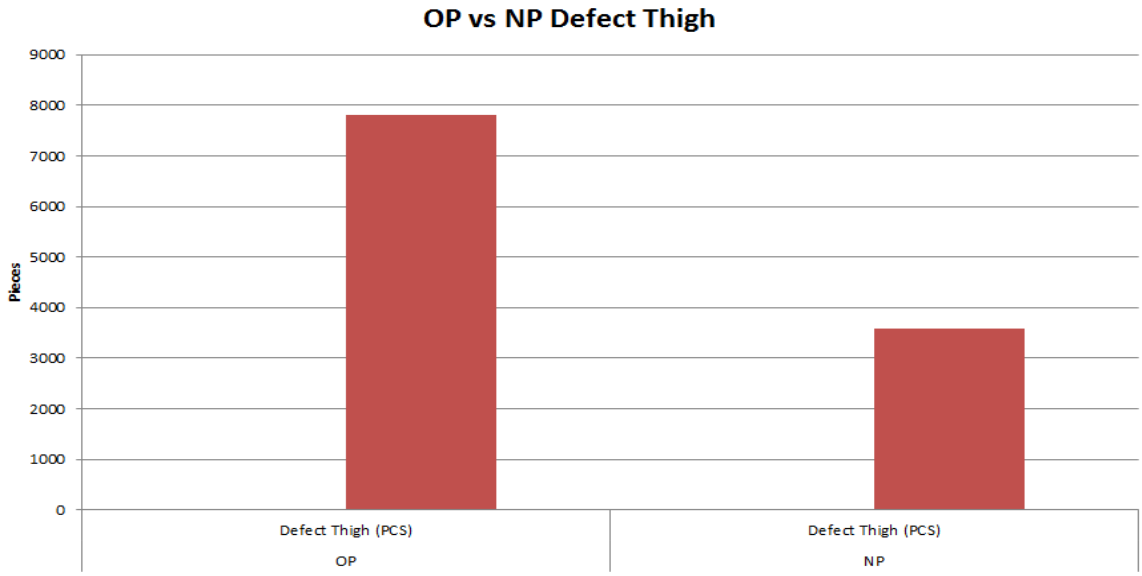

Figure 9. Old Plant versus New Plant Defect Thigh Data

Figure 9 above shows the defect thigh data for M line at old plant and new plant.

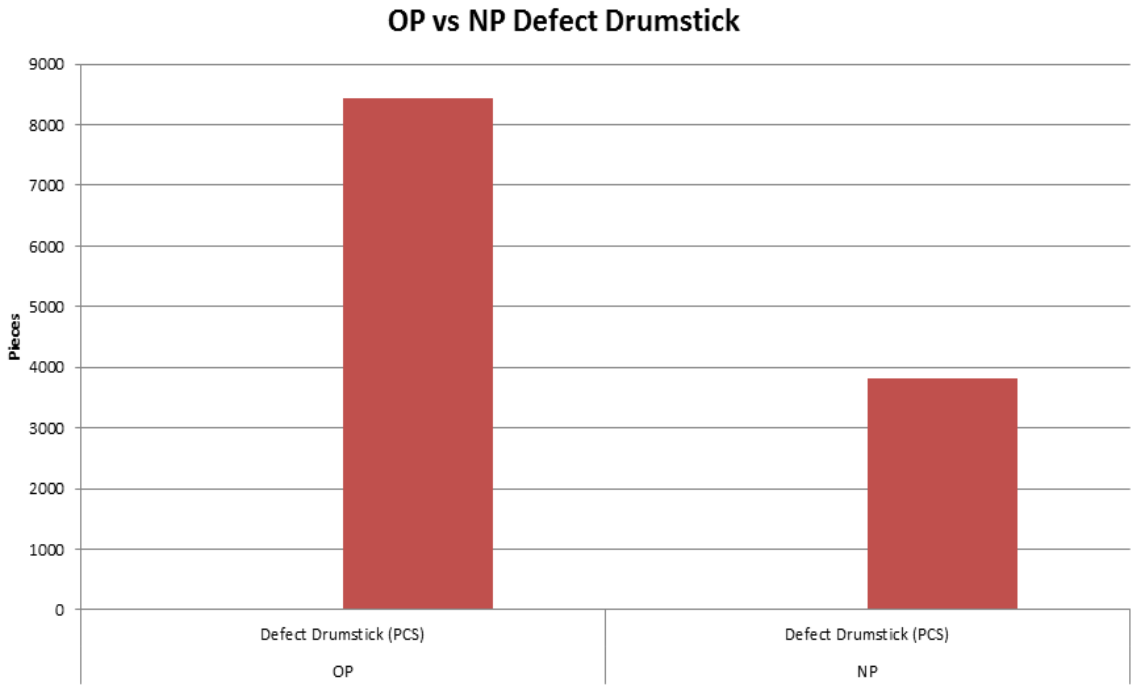

Figure 10. Old Plant versus New Plant Defect Drumstick Data

Figure 10 above shows defect of thigh and drumstick at the old and new plant. The data comparison shows that defect of new plant is almost half of the old plant according to Figure 10. This shows how improved the performance of current plant compared to the previous plant. By reducing the defect, better quality of the parts are achieved.

Calculation for percentage of improvement is shown below.

2019

Mean, $\overline{X} = \frac{7807+8438}{2} = \frac{16245}{2} = 8122.5$

2020

Mean, $\overline{X} = \frac{3582+3820}{2} = \frac{7402}{2} = 3701$

Percentage of improvement = $\frac{8122.5-3701}{8122.5} = 54.4\%$

The calculation above shows rejection rate reduced by 54.4%.

The data recorded on some days are low due to the weight of whole birds distributed to this production line. It's because of the different types of weight of whole birds received from farm. Only whole birds with certain weight range are used at this line for cutting so that weight of the parts can be achieved according to customers' demands. So, whenever the whole birds received from farm with the weight range needed at this line increase, the data recorded on that day also increase. This is the reason why the pattern of data recorded fluctuates.

4. Conclusion

Productivity rate increased by 903% from 20,306.5 to 203,713 birds processed per month at New Plant by using fully automation system (Technology from Netherland). Rejection rate reduced by 54.4% {Oct 2019|Jan 2020}. Grading process for chicken thigh improved by 2882% {Oct 2019|Jan 2020}. Grading process for chicken drumstick improved by 2956% {Oct 2019|Jan 2020}. Lead time for grading process improved by 453% for thigh parts and 464% for drumstick parts. Grading process for chicken thigh and drumstick consistency at about $313901.25 \pm 72737.75695$ and $74309.4375 \pm 249184.3261$ at the New Plant (Jan – April 2020).

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ESTABLISHING MANPOWER COMBINATIONS FOR MANUAL INSPECTION AND SORTING IN A POULTRY PROCESSING INDUSTRY USING WORK MEASUREMENT

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Abstract: This project is to establish manpower combinations for manual inspection and sorting of giblets and feet of broiler chicken at a poultry processing industry. As this particular industry is intended to increase the current production rate from 80,000 products/per day to 300,000 products/per day, it is essential to identify the workers with optimum capability in doing the job task. In this selection process, it is necessary to consider the worker's productivity, generally the productivity rate of employees is one of the key factors for the increment of the production and profitability of an industry. As a result of the new combinations, the organization could benefit in the terms of reducing manpower used for manual inspection and utilize those opted out workers for other job tasks. The method of the study is a combination of work measurement and manpower planning. The data necessary for the method are the productivity level of each worker and the total output of the workers in inspection and sorting tasks of the products. The data is observed and recorded for every 30 minutes. The outcome of the project is the manpower combinations for inspection and sorting work.

Keywords: *Manpower planning; Work measurement; Labour Productivity.*

1. Introduction

Nowadays, industries start to focus on optimizing the productivity of the organization with minimal changes. Yet, it is hard to achieve as there are few underneath constraints. Most commonly is the costs associated with the replacement of manpower with new technology (machinery) or recruitment of new skilled/ unskilled workers for these optimization processes to be successful. The productivity level of an organization can be optimized by arranging and allocating the available manpower wisely.

Productivity of workers has a strong relationship with the optimization of production in an organization. Many scholars have found that productivity is the ratio of outcome and the time it takes to fulfill. So, a system is considered as more productive, when it consumes less time to achieve the desired result. Optimized manpower utilization can be an added advantage to the increment of the productivity of an organization (Salehi et al., 2013).

Next, wise allocation of workforce or manpower planning is a crucial factor in satisfying the productivity target. Manpower planning is a process of ensuring that there is a constant and sufficient supply of workers within an organization at all times. The main idea of these

process is to assure the availability of the workforce with right skills, in the right number, at the right place and also at the right time (Adekunle and Lucent-Iwhiwhu, 2014). In case of increasing production rate, manpower planning plays a vital role as the right amount of workers with adequate skills will be helpful to an organization in improving its productivity. Thus, it is a must to plan and allocate enough workers based on their capabilities to do any job in a firm. This project highlights on the possible manpower combinations in doing group based jobs and their combined output.

1.1. Problem Statement

Company X is a poultry processing factory. This company is intended to increase their current production rate from 80,000 products/per day to 300,000 products/per day. At the same time, the company is minimizing the workforce and replacing it with new high calibrated machinery. But certain tasks need to be done manually, such as inspection and sorting of giblets (liver with heart and feet). For these work, it is necessary to identify the worker with high capability and ability to achieve the targeted productivity which was set by the firm beforehand. So, the company is facing difficulty in selecting the worker who could cope up with the speed required by the management in order to achieve the production target. As currently, the process of inspection and sorting is being done by both male & female operators, but, once the new machines are started to run, management made the decision to use only female operators for that activity. Next, the manpower selection will not fully contribute to the increment in the production rate. Thus, the selected workers have to be grouped up according to their ability in doing the work. The poor manpower arrangement is also another problem faced by the production team of Company X. It is due to the poor understanding of workers capability. Hence, the production team ends up in allocating the workers with works which is not their forte.

1.2. Objectives

- To study the productivity and efficiency of workers in doing inspection and sorting works
- To identify and allocate the selected workers with high efficiency in doing inspection and sorting works.
- To reduce manpower utilized for manual inspection and sorting.

1.3. Scope

The scope of these study are:

- Focused on inspection and sorting works in preliminary department in a poultry processing company
- The product selected for the research is liver & heart and feet, both products will be inspected and sorted according to its grade.
- The productivity of each workers doing the inspection and sorting works is observed.
- Both the work will be done in groups, thus, the overall productivity will be calculated in order to form group of workers.

1.4. Outcome

At the end of the study, it is expected to obtain, identify and form the best combinations of workers with optimum productivity in doing manual inspection and sorting works. It is also expected to reduce the number of workers used for manual inspection and utilize the filtered out workers for other job areas.

This project focuses on manpower allocation and group combination for inspection and sorting work. In order to increase the production rate and achieve the targeted productivity, it is necessary to identify the worker with high efficiency, select them based on their ability to cope up with the speed as required by management in doing the inspection and sorting works, and establish new manpower combination for those tasks as well. The method of the study is a combination of work measurement and manpower planning for the group based task. The data necessary for the method are the productivity level of each worker and the total output of the workers in inspection and sorting tasks of the products. The outcomes of the study will be establishment of manpower combinations for inspection and sorting work. Next, reduce those unfit workers and utilize them into other job tasks. These benefits the firm and the production team in allocating the works to workers according to their capabilities and selecting the right person for the right place.

2. Literature Review

2.1 Manpower Planning

The concept of manpower planning refers to a method of having the right number of people at the right time with the right qualifications , skills and additionally experience in that particular job. Authors Agabi and Ogah identified manpower planning as a method of predicting an organization's human resource needs. It is also described as a way of establishing targets that could improve the firm's ability to achieve the needs, identifying relevant resource requirements and developing plans to achieve the defined goals of the firm (Adekunle and Lucent-Iwhiwhu, 2014).

2.2 Productivity

In general, productivity is concerned with the relationship between the output generated by the production process or a service system and the input provided to obtain this output (Singh, 2016). In scholar’s view, productivity is seen as a more efficient use of resources such as labour and machinery which, if accurately calculated, can efficiently indicate output or efficiency. Author M.Salehi et. al, explored the input and output models for the productivity measurement. The input model is classified into two which is single factor productivity and multifactor productivity. Single factor productivity is a method of calculating productivity with a set of output with single input. Multifactor productivity is calculated by a blend of some inputs and outputs. The productivity obtained based on capital and labour inputs or based on a combination of capital, labour, resources, material, and services is among the most popular types of productivity in this method. Basically, labour productivity is an example of single factor productivity. The ratio of output per person is labour productivity. Apparently, a worker's output is measured by labor productivity. There are different ways of determining labour input: working time (man hour), paying labour costs, amount of workers, and amount of direct labour (Salehi et al., 2013).

2.3 Work Measurement

Work measurement is a tool which consists of several techniques can be applied in order to determine the time needed to accomplish a task and set the time for a skilled worker to perform the job at a specified performance rate. The purpose of work measurement is for manpower planning, production planning and scheduling, cost reduction and control, comparing alternative methods, and workers performance appraisal. By applying work measurement an organization could acquire the basic information required for all the activities of organizing and managing the business of the particular firm where the time element is vital (Kanawaty, 1992).

2.4 Work Measurement Techniques

Authors Mehta.A.D and Desai.D.A have classified the work measurement techniques into three generations. The first generation is an estimation method where the standard time is obtained and the productivity is analyzed by using SWAG and historical data techniques. The second generation is measuring the work through direct observation and measurement by stopwatch study or sampling techniques. The third generation is a method where intervention of IT is utilized and this generation is known as a predetermined time system. There are three techniques used in this approach which are MODAPTS, MOST, and MTM. Among those types of work measurement techniques, the time study also known as the stopwatch study has been the most common technique used by many industries and researchers to measure the work time as it is a cost efficient method (Mehta and Desai, 2014).

3. Methodology

3.1. Flow of the study

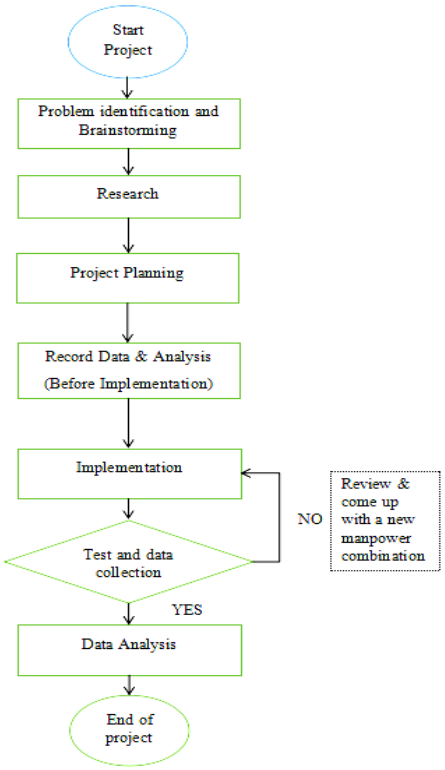

Figure 1. Process flow of the study

Firstly, the research problem which is poor manpower arrangement for manual inspection and sorting of feet & liver with heart of poultry broilers at Company X was identified. The root cause of the problems were analyzed in a discussion with the production supervisors. Later, the research on the literature of study background was conducted. This was done in order to gain knowledge on the method of planning and collecting data for the project. Selected 10 employees randomly, those who are familiar with the job task and permanent staff of the firm not a foreigner (contract worker). Each operator is identified as operators A, B, C, D, E, F, G, H, I and J. Next, a productivity test was conducted by using work measurement technique. The data obtained were recorded in a data sheet. The data collected was the output rate of those selected workers in doing inspection and sorting of both products in 30 minutes. The products are weighed once 30 minutes are over and the weight of the product is recorded as the output of each worker. The data collection was conducted for 1 month and at 3 times per week in order to obtain the average output of each worker. Then, the output data were analyzed by using Labour productivity measures. The average productivity of each worker is also obtained to know whether each worker is able to achieve the targeted productivity. Establish manpower combinations based on the analysis.

3.2. Targeted Productivity

Company X has fixed the productivity rate for inspection and sorting of both products. Thus, the worker's productivity is compared to the target.

- The targeted productivity of Liver + Heart = 68 kg/ per man hour
- The targeted productivity of Feet = 140 kg/ per man hour

3.3. Data Analysis Tool

3.3.1. Bar Charts

The bar charts were developed in order to investigate the performance level of each operator. The level of output is compared to the targeted productivity to identify the poorly performing operators who are unable to meet the target or not even producing nearly to the target. This is helpful in terms of selection of operators for combination establishment.

3.3.2. Formulas

The productivity of each operator is calculated by the Labour productivity measures. As in labour productivity, the productivity is estimated by a collection of outputs and a single input. In this study, the productivity is measured by using the sum of output for each set of data collected (output) for 30 minutes and the number of operators (input) as refer to Equation 1 and Equation 2 (Salehi et al., 2013).

$$\text{Labour Productivity} = \frac{\text{Output}}{\text{Labour Input}} \quad (1)$$

$$\begin{aligned}\text{Labour Input} &= \text{No.of operator} \times \text{time taken to acquire those output} \\ &= \text{No.of operator} \times 0.5\end{aligned} \quad (2)$$

Next, average productivity is the sum of productivity of a week divided by the number of sets of data collected. As the output is recorded 3 times per week, it is necessary to identify the average productivity of each operator as refer to Equation 3.

$$Average\,Productivity = \frac{\sum Productivity\ of\ each\ Reading}{3} \tag{3}$$

3 is the sets of data collected

The average output is the sum of output of an operator divided by the number of sets of data collected each operator as refer to Equation 4.

$$Average\,Output = \frac{\sum Output\ of\ each\ operator}{3} \tag{4}$$

The amount of difference of actual output with the target. The amount of difference in output with the target is identified in order to know the amount of output required to meet the target, for those whose output is beyond the target it is used to know how much does that person have produced beyond the target. In short, it is calculated in order to identify how much the average labour output differs with the targeted output each operator as refer to Equation 5 and Equation 6.

$$Percentage\ of\ output = \frac{Average\,Output}{Targeted\,Output} \times 100\% \tag{5}$$

$$\text{Amount of Difference} = 100\% - \text{Percentage of output} \tag{6}$$

The percentage of change in average productivity before and after implementation. This is to identify the amount of productivity increment after implementation as refer to Equation 7.

$$Percentage\ of\ change = \frac{V_2 - V_1}{V_1} \times 100\% \tag{7}$$

V_2 = Average productivity After Implementation

V_1 = Average productivity Before Implementation

4. Result

4.1. Before Implementation

The sum of productivity of 10 operators is calculated for each set of data. Based on figure 2 and 3, the average productivity of each week is below than the targeted productivity. The target is not achieved. According to table 1, for Liver + Heart Inspection and Sorting the average productivity is below the target around 3% to 6%. And based on table 2, it is evident that the average productivity is below the target 4% to 5%. Even though there are 10 operators who were doing the inspection yet the target remained unfulfilled. This is due to operator C and I's productivity is less than the target. Productivity of operator C is behind the

targeted productivity at 43% to 45% in Feet inspection, meanwhile for Liver + Heart the operator is below the targeted productivity around 41% to 47%. The amount of difference in productivity of operator I to the targeted productivity in Feet inspection is 40% to 43% and in Liver + Heart the difference is 36% to 47%.
Comparatively, operator C and I are producing less than other 8 operators. Thus, these 2 operators are filtered out from the list and the combinations were formed by utilizing the rest of the 8 operators.

Table 1. Average Productivity for Inspection and Sorting of Liver + Heart in December 2019

Week	Productivity (kg/per man hour)				Target (kg/per man hour)	Amount of difference
	1st Reading	2nd Reading	3rd Reading	Average		
1	64.04	63.90	63.32	63.75	68	6%
2	64.36	65.37	66.21	65.31	68	4%
3	64.86	64.19	65.85	64.97	68	4%
4	65.55	66.30	66.96	66.27	68	3%

Table 2. Average Productivity for Inspection and Sorting of Feet in December 2019

Week	Productivity (kg/per man hour)			Average Productivity	Target (kg/per man hour)	Amount of difference
	1st Reading	2nd Reading	3rd Reading			
1	134.01	132.32	133.39	133.24	140	5%
2	133.98	136.54	133.76	134.76	140	4%
3	133.04	135.07	134.26	134.12	140	4%
4	133.94	134.13	136.48	134.85	140	4%

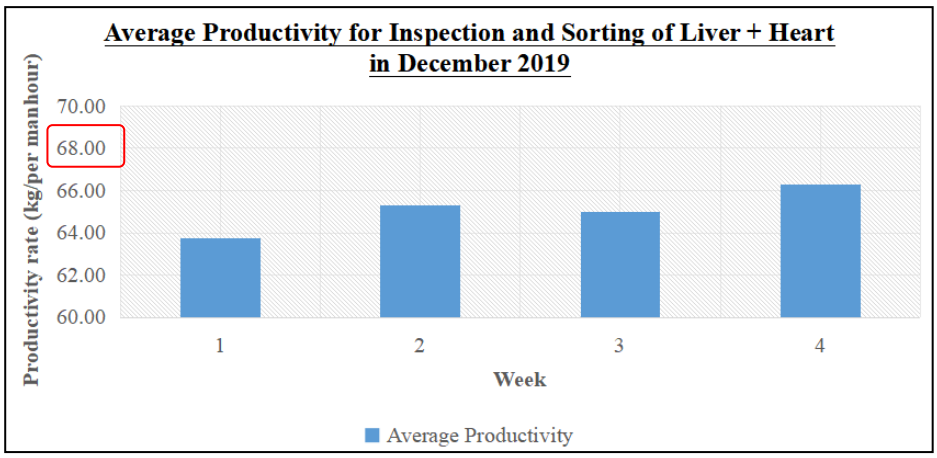

Figure 2. Average Productivity of each week in December 2019 for Liver + Heart Inspection and Sorting

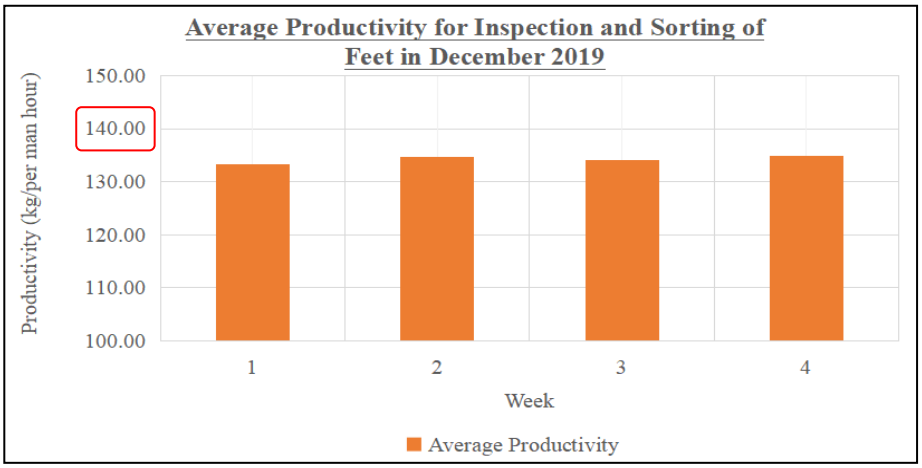

Figure 3. Average Productivity of each week in December 2019 for Feet Inspection and Sorting

4.2. Manpower Combinations

There is 3 combinations established for each product. For Feet, operators D, G and J are those fixed operators as the productivity rate of these 3 operators is averagely at the same level. Based on their productivity, it is clear that they possess the ability to reach the target for feet inspection and sorting easily with their output. For Liver + Heart, operator A and F are selected as the fixed operators. As these two operators achieve the target with their constant output rate. Operators B, E, and H who are manageable both product's inspection & sorting are shuffled act as substitutes in each group.

Table 3. Combinations or groups of Feet Inspection and Sorting

Product	Group	Operator
Feet	1FT	E
		H
		D
		G
		J
	2FT	E
		B
		D
		G
		J
	3FT	H
		B
		D
		G
		J

Table 4. Combinations or groups of Liver + Heart Inspection and Sorting

Product	Group	Operator
Liver + Heart	1LH	A
		B
		F
	2LH	A
		H
		F
	3LH	A
		E
		F

4.3. After Implementation

Table 5. The changes in average productivity of Feet inspection & sorting after implementation

Week	Avg.Productivity Before implementation (kg/per man hour)	Group	Avg.Productivity After implementation (kg/per man hour)	Percentage of Change
1	133.24	1 FT	148.57	12%
		2 FT	142.36	7%
		3 FT	143.92	8%
2	134.76	1 FT	151.61	13%
		2 FT	145.35	8%
		3 FT	145.75	8%
3	134.12	1 FT	153.06	14%
		2 FT	143.76	7%
		3 FT	144.02	7%
4	134.85	1 FT	152.16	13%
		2 FT	145.74	8%
		3 FT	145.37	8%

Table 6. The changes in average productivity of Liver + Heart inspection & sorting after implementation

Week	Avg.Productivity Before implementation (kg/per man hour)	Group	Avg.Productivity After implementation (kg/per man hour)	Percentage of Change
1	63.75	1LH	70.64	11%
		2LH	71.67	12%
		3LH	73.14	15%
2	65.31	1LH	73.14	12%
		2LH	74.72	14%
		3LH	73.96	13%
3	64.97	1LH	73.52	13%
		2LH	75.83	17%
		3LH	73.76	14%
4	66.27	1LH	72.94	10%
		2LH	74.09	12%
		3LH	74.23	12%

5. Discussion

The data obtained after implementation is shown in table 5 and 6, each group achieved the targeted productivity. In feet inspection & sorting activity, the average productivity after implementation increased by 7% to 14%, while in Liver + Heart inspection & sorting activity the percentage increased from 10% to 17%. Thus, the combinations helped the firm in terms of achieving the targeted productivity with minimal workforce. The established combinations effectiveness is proven. As per the theory of manpower planning, when right number of people is placed at right place by considering each one's ability in achieving the target.[2]
The number of workers for inspection and sorting jobs is reduced. The 2 filtered out operators are utilized for other areas within the same department.

6. Conclusion

To conclude, all 3 objectives of the study are achieved. The productivity level of each worker is measured based on their output by using labour productivity measures and the output is recorded by applying work measurement technique. Then, the data obtained were compared to the targeted productivity and analyzed on operators ability to meet the targeted productivity. As the result of analysis, 2 operators are identified as poorly performing and unfit for the job task. Next, few combinations were established neglecting those 2 operators. The total number of operators required for Inspection and Sorting job tasks is reduced from 10 to 8. Those 2 operators are utilized for other areas which requires workers such as veterinary trimming or final bird inspection. As these two segments do not require experts or skilled workers. For future research in this topic it suggested to study on the ways to handle absenteeism and ensure that it does not affect the targeted productivity or the effectiveness of the combinations that have been established.

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DESIGNING AND DEVELOPMENT OF VEHICLE IDENTIFICATION NUMBER (VIN) PUNCHING MACHINE TROLLEY

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Abstract: Musculoskeletal Disorders is serious issue on manufacturing industries due to low awareness of the right working procedure. This study is to find ways to enhance the ergonomics awareness in manufacturing Industry. The project discuss about the technique for the worker to do their job in manufacturing. The project focuses to analyze working posture and low back pain by using working posture evaluation using Rapid Entire Body Assessment (REBA) and Rapid Upper Limb Assessment (RULA) method. This project will be evaluated, examine and recommend a new skill/technique of machine handling as solution to improve current working postures. A work position that not follow right procedure will instantly cause fatigue to the body and will lead to lower productivity and efficiency. At manufacturing company, a lot of work position not following ergonomic aspects at work area which the worker wrongly lift the heavy machine and put a burden on his body.

***Keywords**: Ergonomics Aspects, RULA and REBA Method*

1. Introduction

Ergonomics is important at at workplace and it is designed to enhance the relationship between work environment and workers. This project aims is to run an ergonomic assessment in manufacturing industry. Ergonomic assessment in this project more to enhance the work environment, tools/equipment, work posture while assuring the wellbeing, safety and health of the workers. The improvement that been considered by using the ergonomic evaluation to reduce the risk when doing work at the company. Figure 1 shows the vehicle identification number (VIN) machine is located at punching body work area. The machines is quite heavy and with wrong postures or procedure, it can lead to back pain injuries. There are some standard that have impact on the efficiency, productivity work environment, methods of production and body postures of worker. A work posture has a direct impact on worker's performance and productivity.

Figure 1. VIN machine not follow 5s and Ergonomic Concept (Ohnishi, et al., 2016)

This situation will give some risk to the workers which lead to lower performance than usual. It will leads to some bad effect such as back pain and tiredness to the workers. Besides that, the punching machine is heavy and with wrong postures, it can affect worker safety and performance which lead to serious problem for the company.

2. Methodology

In this design process, there are 3 stage involved as can be seen in Figure 2. Stage 1 involves problem identification and issues regarding heavy machine handling procedure/processes. Stage 2 will be focused based on designing and development of ergonomic trolley for Vin punching machine. Finally, in stage 3, effectiveness of the ergonomic trolley before and after the application will be carried out by the evaluation test.

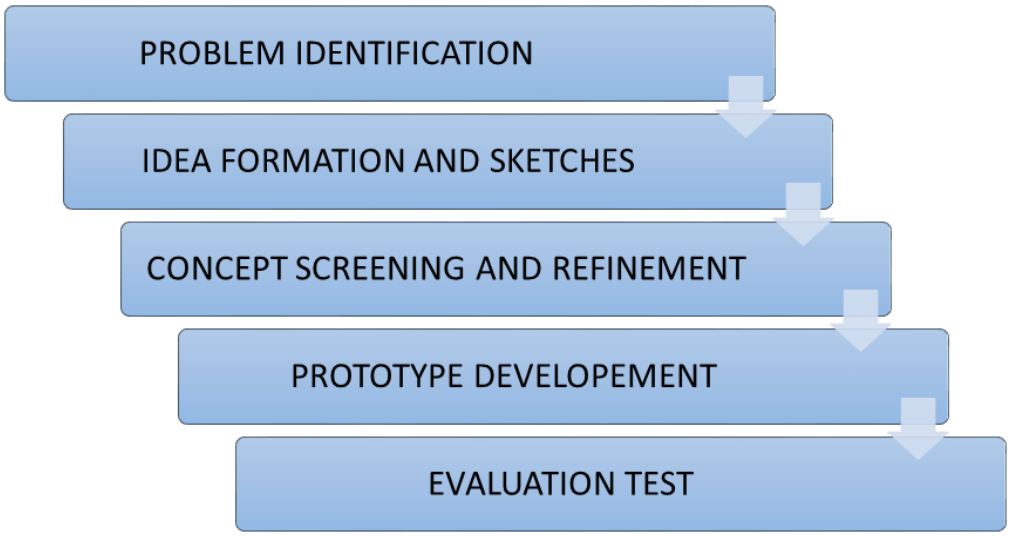

Figure 2. Design Process in this study

2.1. Stage 1: Identification Problems

The problem identification are correlated to the current process of machine handling and was managed through on interview, observation and work procedure at production line, involving the operator that responsible for the operation of punching number at car chassis. The operator has been told about the scope and aim of this project. They were informed that the trolley is about achieving ergonomic aspects at workplace which can improve work performance and safety every worker.

Each operators will be given task to do the work process and need to report if they experience pain on their body through the operation. During the examination, if anyone have any ideas, opinion or issues about the ergonomic, they are encouraged to share it with everyone else. If the ideas is good, it will make as a new solution

2.2. Stage 2: Development of Design

i. Idea Sketches and Formation

The conception of design were created through discussion, reviews of the ideas through brainstorming session. The design must be carefully considered so that the design can be produced and all parts functioning. There are several that should be considered in designing the trolley which is strength, ergonomic factor and suit to work environment. There are 3 design that have been draw by using AutoDesk Inventor.

ii. Conception Screening and Refinement

There are 3 design of the ergonomic trolley but only 1 will be chosen as a final product as refer to Figure 3. The conception screened concepts will be reviewed and evaluated, before choosing last design. The supervisor will provided correction or ideas before selected the final design

iii. Prototype Development

A prototype was built by using steel at body frame. This material is chosen because it has high tensile strength and low cost which meet the requirement for this project. It also use the polyurethane tyre so that the trolley can be used in any production line beside punching body work area.

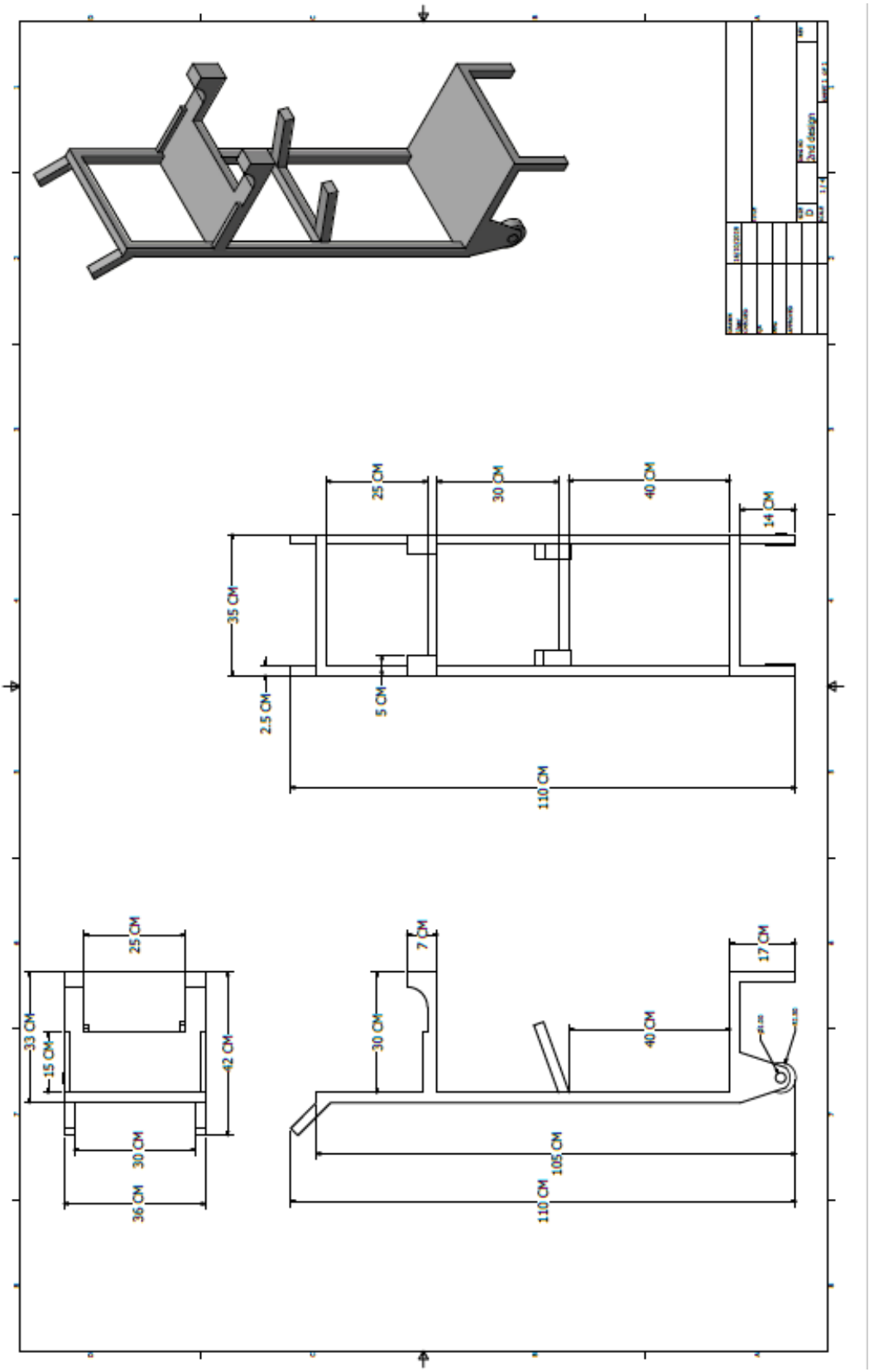

Figure 3. Selected Design

2.3. Stage 3: Evaluation Test

This design mostly focused on the ergonomic and safety of the worker on machine handling at work place. For the measurement of the design, the antropometric data need to be taken. Antropometry is important when something involved in industrial design and ergonomics where statitiscal data about the body dimensions will be taken. Ten Operator will be take their High Elbow Standing (cm) and their Hand Held Diameter (cm) to adjust the trolley according to the anthropometry graph (Dick et al., 2016).

Working posture assessment by using Rapid Upper Limb Assessment (RULA) and Rapid Entire Body Assessment (REBA) was also conducted to access workers subjection to ergonomic risk factors while perfoming punching body process (Van et al., 2010). Table 1 shows the RULA and REBA are the two easiest methods for risk assessment in the workplace. Both of this method is to examine and evaluate the loads that can be taken on musculoskeletal systems when the workers work with risk such as awkward postures, excessive force and static muscle works. The scoring through this method is needed so that the injuries can be reduce on the future.

Table 1. RULA scoring (Dempsey and Hashemi, 1999)

Score	Level of MSD Risk
1-2	neglibible risk, no action required
3-4	low risk, change may be needed
5-6	medium risk, further investigation, change soon
6+	very high risk, implement change now

3. Results

Ergonomic trolley design research to increase productivity is carried out with anthropometric measurement methods on punching body operators. The variables used in this research are trolley operator anthropometric data measurement, measurement of trolley operator process time and measuring productivity levels. The stages of the research that will be carried out are as follows:

a) Data collection
Anthropometric data (elbow standing and hand-held diameter), punching body time data before and after the application of ergonomic trolley, peformance rating before and after applied the ergonomic trolley, allowance before and after applied the ergonomic trolley.

b) Data test
Normaly distribution anthropometric data test, Uniform punching body time before and after the application of ergonomic trolley data test, and machine movement in production line before and after the application of ergonomic trolley data test.

c) Data processing
Anthropometric data used to determine percentile values. If the percentile value has been obtained, then the size of the ergonomic trolley can be design.

3.1. Anthropometric Data for Trolley Operator

The trolley operator Anthropometric data are necessary for trolley design such as hand held diameter and high elbows standing. Table 2 shows anthropometric data from this study.

Table 2. Anthropometric Data

OPERATOR	HIGH ELBOWS STANDING (CM)	HAND HELD DIAMETER (CM)
1	102	5
2	103	5
3	105	6
4	108	7
5	109	9
6	108	9
7	107	8
8	106	5
9	104	4
10	103	4

3.2. Anthropometric Graph

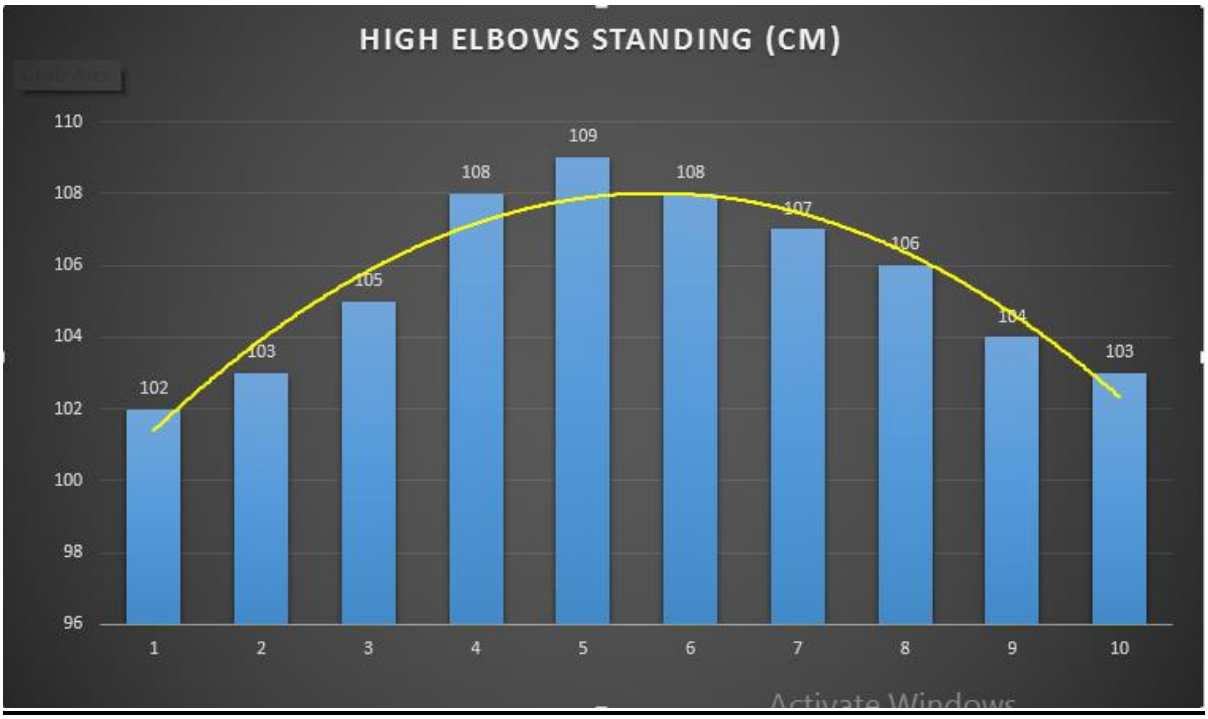

Figure 4. Anthropometric Graph for High Elbows Standing (cm)

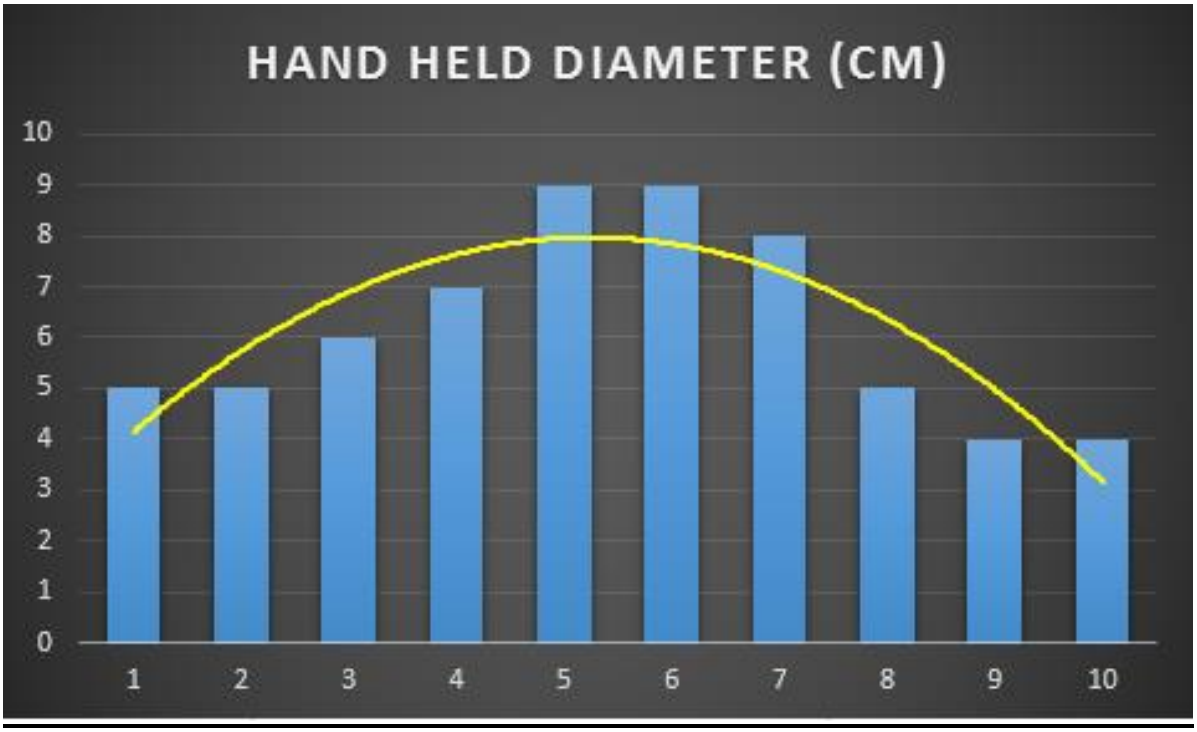

Figure 5. Anthropometric Graph for Hand Held Diameter

Figure 4 and Figure 5 show the Ergonomics of trolleys are designed based on percentile values for high size the trolley is taken from the 5th percentile to 95th percentile value of the standing elbow which is 108 cm. . The height range of a cart handle from the floor should be about 94 cm (37 in) to 117 cm (46 in). While for the diameter size the trolley handle is taken from the 5-th percentile value of the hand grip diameter from 2.5 – 4 cm.

3.3.REBA and RULA

While performing the punching body process from key in data to lift the machine and punching the vin, the REBA and RULA methods were used to examine and evaluated the posture body when operate the machine. As for handling process, there are four section of REBA and RULA analysis. Table 3, 4, 5 and 6 shows the average REBA and RULA scores. As for the current method, REBA and RULA scores will be conducted through the process that involved in the punching body process.

Table 3. RULA scores of current method

OPERATOR	RULA SCORES BY OPERATORS		
	POSTURE SEGMENT		
	Key in Data	Lifting the machine	Transfer to production line 1
1	4	5	7
2	5	6	7
3	5	6	6
4	6	6	6

Rula score of 1 or 2 = allowable, 3 or 4 = look into further, 5 or 6 = look into further and adjust soon, 7 = will be analyzed and resolve immediately

Table 4. REBA scores of current handling method.

OPERATOR	REBA SCORES BY OPERATORS		
	POSTURE SEGMENT		
	Key in Data	Lifting the machine	Transfer to production line 1
1	7	10	11
2	6	11	11
3	6	9	10
4	8	8	10

REBA final score of 1 = lowest risk ; 2–3 = change may be needed; 4–7 = need to do investigation, will change soon; 8–10 = high risk for the body ; 11+ = very high risk, changes will be carried out immediately.

Table 5. RULA scores of the new handling method

OPERATOR	RULA SCORES BY OPERATORS		
	POSTURE SEGMENT		
	Key in Data	Lifting the machine	Transfer to production line 1
1	2	3	2
2	3	3	3
3	3	4	4
4	2	4	2

Rula Final score of 1 or 2 = allowable, 3 or 4 = look into further, 5 or 6 = look into further and adjust soon, 7 = will be analyzed and resolve immediately

Table 6. REBA scores of the new handling method

OPERATOR	REBA SCORES BY OPERATORS		
	POSTURE SEGMENT		
	Key in Data	Lifting the machine	Transfer to production line 1
1	4	5	3
2	3	7	4
3	5	5	4
4	4	6	5

REBA final score of 1 = lowest risk; 2–3 = change may be needed; 4–7 = need to do investigation, will change soon; 8–10 = high risk for the body; 11+ = very high risk, changes will be carried out immediately.

As for evaluation test, RULA scores has been reduced from 4–7 to 2–4 levels across all four posture segments after the used of ergonomic trolley. Scores of 3–4 said that it will be looked and investigate further, whereas scores of 5–6 will investigate further and changes need to be made. As for the highest scores which is 7, it will be analysed and need to resolve immediately. As for the REBA scores, it decreases significantly from score 6-11 to 3-6 after the application of ergonomic trolley.

3.4. Final Product

Figure 6. Front View

Figure 7. Behind View

4. Discussion

From the findings, the final product has contributing a lot of improvement at workplace, equipment and environment. The inputs from the operator by doing brainstorming session have led to the successful final design and product. Each of the ideas that been considered while brainstorming session has led to this final product. In the evaluation test of this ergonomic trolley, it has achieved its goal which is to follow the ergonomic concept at work place and to lower the risk of lower back pain. As for the productivity and efficiency terms, the final product can reduce the time taken when doing punching body job compared to time taken before the application of ergonomic trolley. In terms of safety and health, the ergonomic trolley provides a better work postures compared to the old ones. Besides that, operator also can push the trolley and bring the machine to any production line compared to the old method that need to lift the heavy machine which lead to serious back pain.

Although the final product is fully functional, it still need a lot of need a lot of improvement. For example, we can see that from RULA scores of new handling method is 2-4 which still need to improve. As for REBA scores of new handling method also need a lot of improvement since the score is 3-6 which is good but still need an improvement.

5. Conclusion

An ergonomic trolley has been design firtsly and developed in this study. The working operation for punching body has been successfully tested in manual handling of heavy machine and it can be seen that the safety and health and work efficiency has improved tremendously. Beside that, safety of manual handling also has been improved a lot as we can seen that it give minimal low back pain and excessive force at workplace. Finally, the developed ergonomic trolley gives the the worker a better working and can be seen in reduction of REBA and RULA scores after the application of the ergonomic trolley. Besides that, it also eliminates the manual handling while to bring the machine anywhere.

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