*Proceedings of the 2016 International Conference on Industrial Engineering and Operations Management*
*Kuala Lumpur, Malaysia, March 8-10, 2016*

# Improvement of Productivity Rate of JIT #262, Creams, Liquids, Lotions Department of a Cosmetics Company

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***Abstract*— The study aimed to determine the factors affecting the productivity of JIT #262 and to find ways on how to improve the line's productivity by applying basic quality control tools to interpret and analyze the data; and determine the factors that affect the downtime of machines. The data were gathered and analyzed using some of the basic Quality Control Tools such as Check Sheets, Pareto Chart and Cause and Effect or Fishbone Diagram. The researcher conducted the study for the succeeding three months of the second term of school year 2010-2011. Based on the analysis of the Fishbone diagram, three factors such as the Man, Machine and Materials contributes to the low productivity of the line. The line graphs show that the current productivity of the line is relatively low based on the information gathered from August to October 2010. The analysis using the Pareto Chart has suggested that issues with the capping machine makes up 78% of the causes of the line's low productivity.**

***Keywords*** **– Productivity, Quality control tools**

## I. INTRODUCTION

This Cosmetics Company is one of the oldest manufacturing companies today in the United States that specializes in beauty products. It started from a simple door-to-door seller of books who gives out perfumes to attract customers. The company now manufactures and sells fragrances, cosmetics, toiletries, apparels, accessories and various home furnishing items and has already expanded its business throughout the world including the Philippines. The company first resided at Libis, Metro Manila in 1978 and was relocated in Calamba, Laguna eighteen years after.

The company's manufacturing plant consists of three packaging business units – Hot-Melts and Mascara (HMM); Powders, Hydro-Alcohols (PHA); and Creams, Liquids, Lotions (CLL). The company's well known lotions are processed and packaged in the Creams, Liquids, Lotions (CLL) Department. JIT # 262 is one of the lines that packages different lotion variants. The operation is divided into five elements- bottle loading, lotion filling, capping, packing and case sealing that requires a few people to do the job.

The line requires five people to operate. In some occasions where demand is very high or there is an occurrence of machine breakdown, additional workers are needed to meet the demand for the given period. Additional workers result to additional costs in terms of labor hours which results to increased wages for the company's end. These additional costs also contribute to the shift in the rate of productivity of the line.

Productivity is defined as the ratio between the outputs and inputs. Outputs refer to the actual production in units, while inputs may refer to different factors such as labor, capital, and technology. Measuring productivity is very important in businesses as this can lead to improved worker compensation without sacrificing the cost of their products and services they produce.

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Pritchard (1990) stated that productivity rate varies from time to time, depending on both the machine's and the worker's condition. Most companies today define productivity as anything that makes an organization function better. Productivity is measured by the effectiveness and efficiency of the process, as well as other factors including innovation, turnover and morale.

The Japanese realized that quality products cannot be consistently produced with poorly-maintained equipment; hence, the Total Productive Maintenance or TPM was designed to support the Total Quality Management (TQM) strategy (Wireman, 2004). The goals of TPM are a) to improve the effectiveness of the equipment, b) to improve the maintenance efficiency and effectiveness, c) to practice equipment management and maintenance, d) to train the people involved to improve their skills, and e) to involve the operators or occupants in the routine maintenance. With these goals, non-value adding activities such as waiting and reworking can be eliminated in an operation. (Wireman, 2004)

## II. METHODOLOGY

The department's Daily Packaging Report (DPR) has supplied the researcher the information needed to determine the current productivity of the line, as well as the different types of problems that the line encounters in each operation. The researcher used a) check sheets to determine the frequency of occurrence of the downtimes, b) Pareto Analysis to determine what types of problems need immediate attention, c) Fishbone or Ishikawa Diagram to determine the root causes of problems identified, and d) line graphs to illustrate the trend of productivity of the line versus the standard productivity.

The study aimed to improve the productivity of the line by determining the factors that contribute to the input and by determining the factors that affect the efficiency of the line and the causes of delays and downtime.

As the study progressed, the researcher has determined that the different types of problems the machines in the line encounters every operation contributes greatly to the current productivity of the line.

The study focused on one lotion filling line- JIT #262 where different variant of lotions are being packaged. The researcher focused on the different types of problems that the line experiences in every operation and the current productivity of the line.

### *A. Study Area*

The researcher conducted the study at the Creams, Liquids and Lotions (CLL) Packaging Department of a Cosmetics Company, where different lines of packaging stations of different product variant can be found. There are 10 lines that operate within the area. Each line is named *JIT* with their corresponding numbers.

### *B. Descriptive method and Quantitative Method*

The study involved descriptive and quantitative method. The current process was evaluated, and objectives were formulated on how to approach the study such as: a) determine the current average productivity of the line, b) determine the average number of manning needed in the line, and c) determine the types of problems that the line encounters. The productivity rate of the line was determined by gathering information from the Daily Packaging Report (DPR) that contains the total number of actual labour hours and the total number of units produced per day. The report also contains the timely record of the activities of the line, including the information on the problems encountered during the shift.

### *C. Instrumentation*

The Daily Packaging Report (DPR) supplies the information about the variables needed to compute for the current productivity of the line and the types of problems the line encounters every shift.

The researcher gathered the DPRs for the months of August, September and October 2010 and recorded the information needed – the total number of bottled lotions produced per day for the output variable, and the total actual labour hours per day for the input variable. After the information was gathered, the current productivity rate of the line was computed using the formula:

$$productivity = \frac{output}{input} \qquad (1)$$

*Where*:
Output = total number of bottled lotions produced per day
Input = total actual labour hours per day

After the current productivity of the line was computed, the monthly average productivity rate was computed using the formula for the statistical mean:

$$average\ productivity = \frac{\sum x}{N} \qquad (2)$$

*Where*:
x = current productivity of the line
N = total number of recorded days

*D. Data Analysis*

The researcher used Ishikawa or Fishbone diagram to identify the causes of problems that affect the productivity of the line. The factors that affect the process such as a) Man, b) Machine, c) Materials, d) Method and e) Measurement were listed. The researcher evaluated the process and chose the possible factors that might have an effect on the productivity of the line. The process was further analyzed by putting branches that might have possible connection to the corresponding factor that affects the process.

The Pareto Analysis was used to identify the problems that require immediate attention using check sheets for preliminary gathering of data. After the data were gathered, the individual totals were computed along with the cumulative percentage. The data were tabulated in a graph and 80% of the total problems were identified.

The determined productivity rate of the line was presented in a line graph to compare the rate of productivity to the standard productivity established for the line.

## III. RESULTS

The presentation and discussion of interpretation and analysis of data gathered from the Daily Packaging Report (DPR) in accordance with the specific problems identified in Chapter 1.

This study delved on the improvement of productivity of JIT #262. The major purpose of the study is to determine the factors affecting the efficiency of the line. Such information like the number of units produced per day and the actual labour hours were gathered in order to get the productivity rate of the line as well as the records of machine downtime to solve a perceived problem.

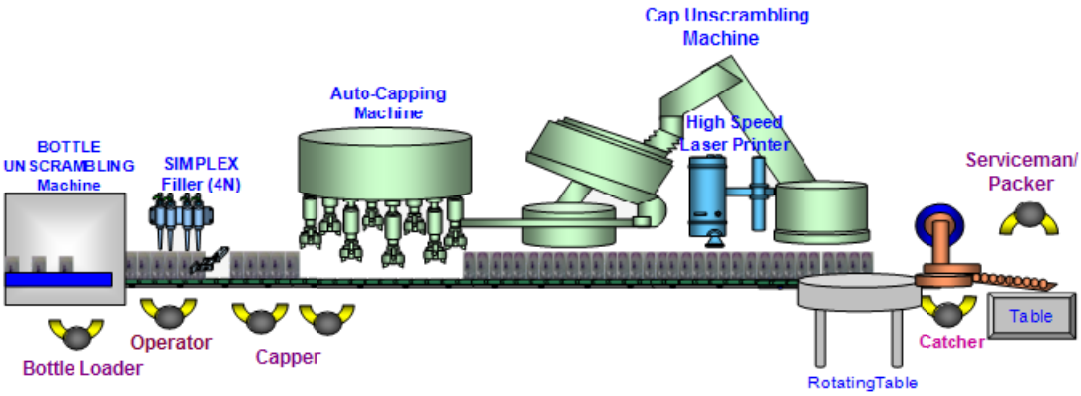


*Fig. 1 Present Layout of the line*

Figure 1 shows the present layout of the line, manned by six people. The bottle loader puts the bottles in the conveyor while the bottle unscrambling machine is down. The operator manually pushes the bottles to secure the fit of the bottle openings with the lotion filler nozzles. There are two manual cappers that place caps on the bottles while the cap

unscrambling machine is down. A catcher puts the bottles to boxes and a serviceman/packer manually places the box to the case sealer. After sealing, the boxes are manually carried to wooden pallets.

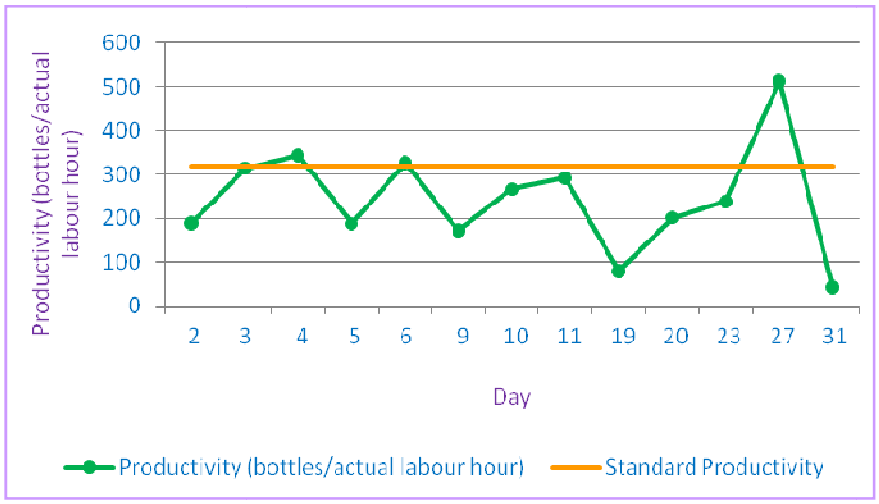


*Fig. 2 Current productivity for first month of study.*

Figure 2 showed that the highest productivity for the month is achieved on the 27th day with a rate of 513 outputs per actual labour hours and the lowest on the 31st day with a rate of 42.51 outputs per actual labour hours. This observed low productivity is due to the long idle time during sanitization. With the computed average productivity of 243 outputs per actual labour hours for this month, the result can be classified as low because the established standard productivity for the machine with a value of 317 outputs per actual labour hours is not reached.

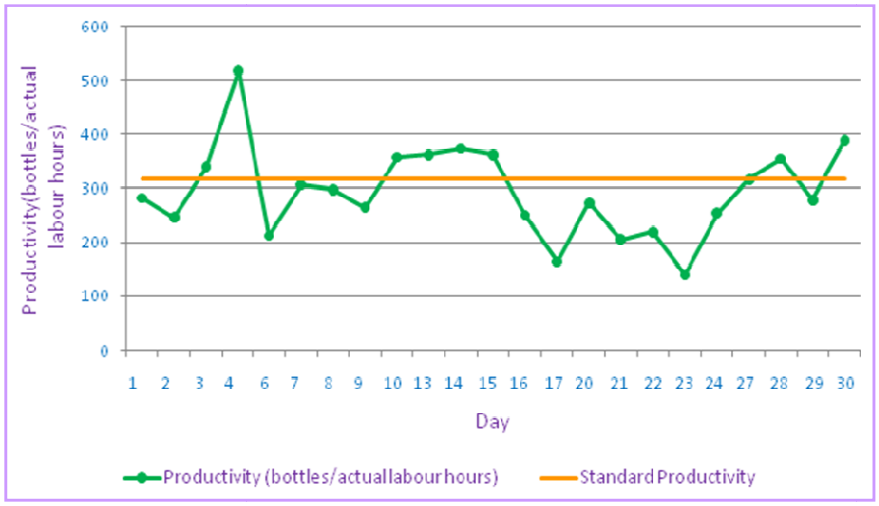


*Fig. 3 Current productivity for second month of study.*

Figure 3 showed that the highest productivity for the 2nd month is achieved on the 4th day with a rate of 518 outputs per actual labour hours and the lowest on the 23rd day with a rate of 140 outputs per actual labour hours. With the computed average productivity of 294 outputs per actual labour hours for this month, the result can be classified as low because the established standard productivity for the machine with a value of 317 outputs per actual labour hours is not reached.

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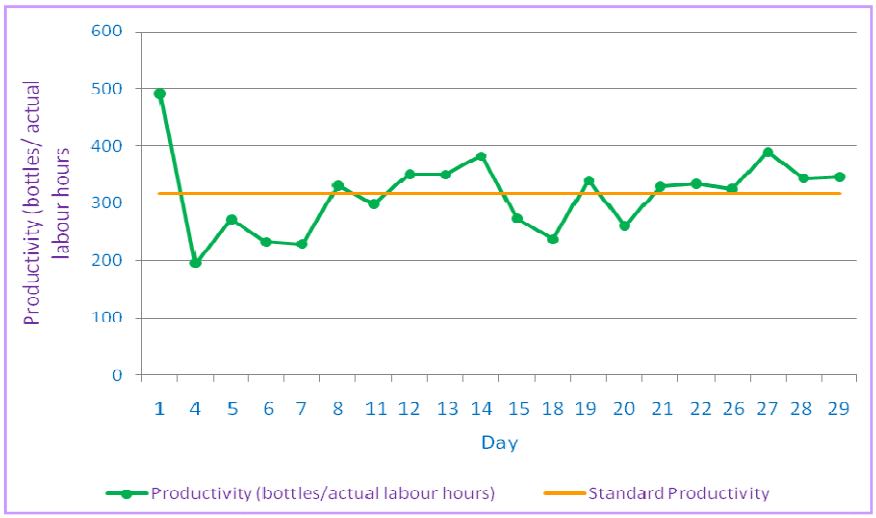


*Fig. 4 Current productivity for third month of study.*

Figure 4 showed that the highest productivity for the 3rd month is achieved 1st day with a rate of 492 outputs per actual labour hours and the lowest on the 4th day with a rate of 196 outputs per actual labour hours. With the computed average productivity of 294 outputs per actual labour hours for this month, the result can be classified as low because the established standard productivity for the machine with a value of 316 outputs per actual labour hours is not reached.

**Tools Used**

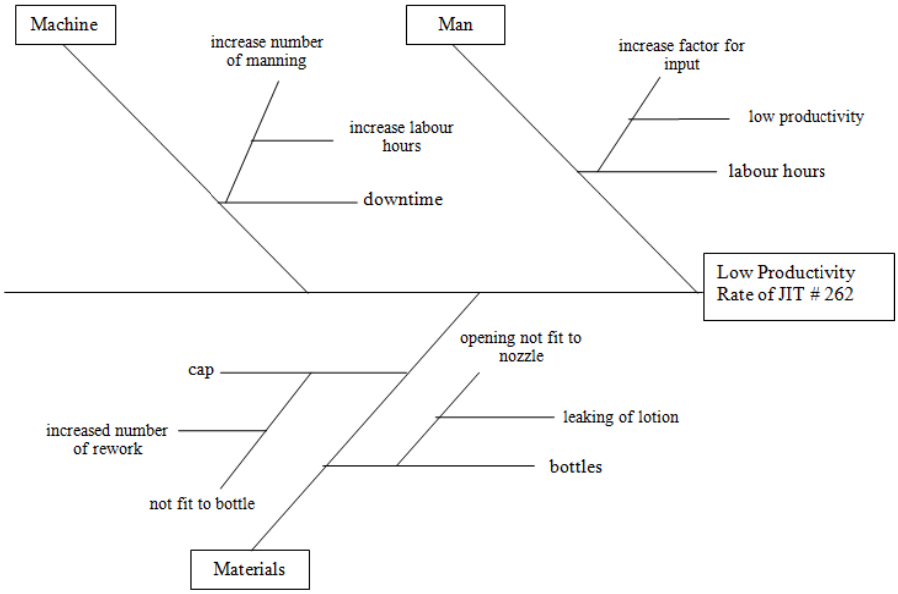


*Fig. 5 Cause and Effect Diagram.*

The Cause and Effect Diagram showed the three factors affecting the productivity of the line- Man, Machine, and Materials. Based on the results, these factors are closely related to each other. Under the factor of Man, the labour hours increase the input variable, which can affect the rate of productivity. An increase in the input variable may shift the value of productivity, depending on the output variable. The Machine factor showed that the downtime of the machine can increase the number of manning in the line, and will therefore increase the input variable which can cause a deviation in the rate of productivity. The Materials factor showed that the bottle and the cap used in the packaging of the lotion contributes to low productivity. The small opening of the bottle requires a man to push the bottles manually to avoid leaking of lotion. In this case, it means an increase in the number of manning, resulting to an increase in the input variable, thus, affecting the rate of

productivity. The caps not fit to bottles increases the number of rework, as it requires additional manning to correct the misplaced caps. This results to an increase in the actual labour hours, thereby causing a deviation in the rate of productivity.

*Table 1. Check Sheet for the types of problems encountered in the line production*

| CLL Packaging Department JIT # 262 Productivity Problems For the months August to October | | | | |
|---|---|---|---|---|
| Problem Type | Month 1 | Month 2 | Month 3 | Total |
| Capping Machine problem | 59 | 21 | 39 | 119 |
| DLC Problem | 4 | 5 | 8 | 17 |
| Nozzle problem | 7 | 1 | 7 | 15 |
| Component problem | 0 | 0 | 2 | 2 |
| Total | | | | 153 |

Table 1 shows the different types of problems the line encounters every operation for the months of August to October 2010. The different types of problems were tallied and arranged according to the highest contributor.

*Table 2. Pareto Data Sheet for the types of problem encountered in the line production*

| Problem Type | Total | Individual Percentage | Cumulative Total | Cumulative Percentage |
|---|---|---|---|---|
| Capping Machine problem | 119 | 77.78% | 119 | 77.78% |
| DLC Problem | 17 | 11.11% | 136 | 88.89% |
| Nozzle problem | 15 | 9.80% | 151 | 98.69% |
| Component problem | 2 | 1.31% | 153 | 100.00% |
| Total | 153 | | | |

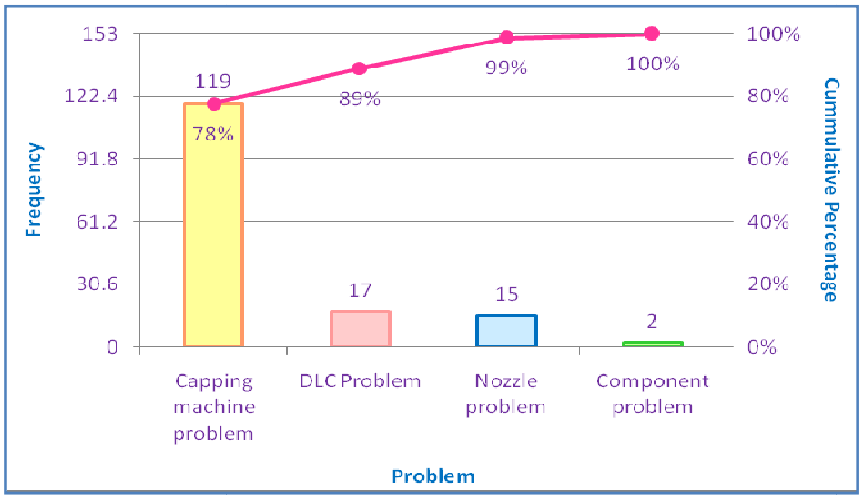


*Fig. 6 Pareto Chart for the different types of problems*

Referring to the chart, capping machine problem needs immediate attention. Based on Pareto's 80-20 rule, the capping machine problem consist 20% of the problems that affects the productivity of the line.

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*Analysis and Interpretation*

**Plan of action for the problems encountered in the production line**

**Capping machine problem** – timely adjustment of the capping machine results to stoppages. When the cap unscrambling machine is down, two operators are added on the line to fill in with the placing of caps in the bottles.
*Action*: Timely check up for the capping machine
*Advantage*: The line will maintain the standard number of manning required for every operation.
*Disadvantage*: Idle operators from other line cannot fill in for the line.

**DLC Problem –** problem with DLC results to no print of manufacturing date in the bottles which keeps the catcher idle.
*Action***:** Coordinate with the maintenance department for timely check up of the laser printer.
*Advantage*: Minimize the idle time of the catcher and enables completion of the operation on a given time frame.
*Disadvantage*: More maintenance crew will be needed for the timely check up.

**Nozzle problem –** the nozzles are not fit to the bottle opening which requires the operator to manually push the bottles to make sure there will be no leaking of lotion. This results to inefficiency of the operator and kept him from doing other tasks.
*Action*: Install a screw conveyor for the filling station to ensure the fit of nozzles and avoid lotion leaking.
*Advantage*: The operator who used to be pushing the bottles manually can do other tasks like check other machines in the line and monitor the progress of the line.
*Disadvantage*: Installation of screw conveyor will add cost for the company.

**Component problem** – the cap is not fit with the bottle opening, which results to the adjustment of the capping machine.
*Action*: redesigning of the product packaging
*Advantage*: the number of rejected components will be lessened and the number of units that needs reworking can be minimized.
*Disadvantage*: The redesigning of the bottles can take a lot of time.

**Unstable movement of bottles** – unstable movement of the bottles results to tripping which requires an operator to pick the bottle and arrange it accordingly.
*Action*: Install padding on the conveyor belt to increase the friction to keep the bottles from tripping or falling down. This allows the bottles to keep up with the conveyor speed until the bottles reach the lotion filling station.
*Advantage*: The modification of the conveyor belt will minimize the time spent by the operator picking up fallen bottles or fixing tripped bottles, as well as eliminate the bottle loader in the line.
*Disadvantage*: Installation of padding will impose an extra cost for the company.

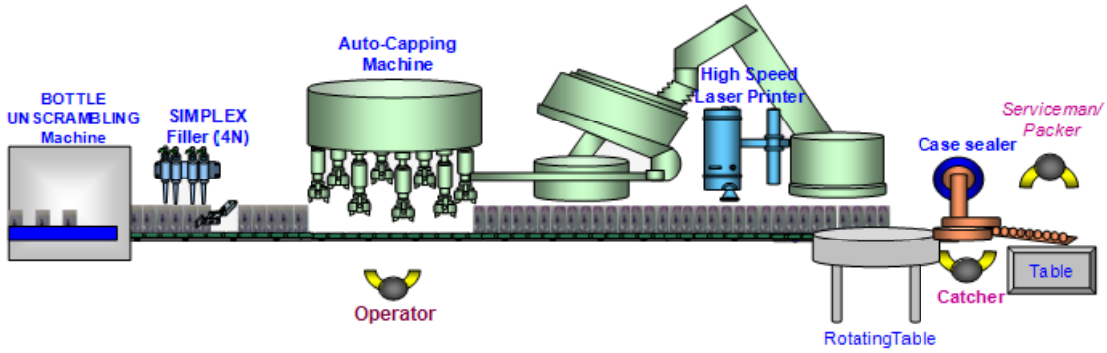


*Fig.7 Proposed layout of the line*

Figure 7 shows the proposed layout for JIT #262, where three operators are deployed. An operator that can monitor every process in the line, a catcher that inspects and puts the units in the boxes, and a serviceman/packer who can look out for the machines and carry the boxes to the case sealing machine and then to the pallet.

**Cost-Benefit Analysis**

Upon careful study of the proposed layout, the following is the cost and benefit of the company:

*Cost*

The number of manning in the line will be reduced to three people, which entails the company to lay off the excess manning.

*Benefit*

The reduction of manning in the line can make a lot of annual savings for the company. The figures in Peso are shown in the Table 3.

*Table 3. Comparison of Current and Proposed layout*

| Number of manning | Actual labour hours in 250 days | Assumed rate per hour | Total labour cost per year |
|---|---|---|---|
| 6 | 6,000 | Php 50.00 | Php 1,800,000.00 |
| 3 | 6,000 | Php 50.00 | Php 900,000.00 |

Table 3 shows the comparison of the actual and proposed layout in terms of labor cost per year. Referring to the table with an assumed rate per hour, the total cost for six manning is P 1,800,000.00, while three manning reduces the cost to half, with an amount of P 900,000.00.

## IV. Conclusion And Recommendation

*Conclusion*

In light of the significant findings derived from the study, the researcher have arrived at the following conclusions:

The current productivity of the line for the three month-period is relatively low compared to the established productivity standard of the company.

The three factors identified using the Cause and Effect Diagram affects the process by requiring additional manning which increases the weight on the input variable. An increase in the input variable causes a deviation in the computation of productivity rate.

With an occurrence of 119 tallied from the months of August to October 2010, the problem with the capping machine is the largest contributor that affects the current productivity of the line.

The productivity of the line depends on the number of units produced (output) and the actual labour hours (input). If the output is high with a low value for the input, the highest attainable rate of productivity is attained. On the other hand, if the value of the output remained the same with an additional number for the input, the productivity rate will drop. Conversely, if both the variables are increased, no change in the productivity rate will be observed.

*Recommendation*

In view of the findings and conclusions formulated in this study, the following recommendations for future studies are hereby offered for considerations:

*Application of Ergonomics* – Ergonomics is the science of fitting the job to the person. The application of ergonomics in the production line will identify the worker conditions that will increase worker efficiency.
*Work Sampling* – this study will determine the percentage of time the machine and worker are idle or productive.
*Total Preventive Maintenance* – this study will reduce the machine downtime.

## Acknowledgment

The presentation and publication of this paper is supported by Malayan Colleges Laguna, Philippines.

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