A Facility Layout Improvement Design Model in Selected Garments Manufacturing in Metro Manila

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Abstract

This study proposes a facility layout improvement design model that aims to improve the labor productivity in selected garments manufacturing in Metro Manila. According to study, facilities layout design is one of the key areas, which have significant contribution towards manufacturing productivity in terms of cost and time, in a manufacturing system (Tompkins, 2003). This research design includes an integration of process analysis, facility design and plant layout using SimRunner software. In this study, layout design factors were identified to determine its significant affect to the labor productivity such as number of units produced, processing time, number of workstations, distance travelled and resource utilization. The factors were analyzed and compared using different types of facility layout like U-shape, P-shape, I-shape, S-shape and J-shape layout. It was proved in the study that J-shape layout resulted in the highest % improvement of 95.8% in labor productivity and yielded the highest output, shortest processing time, shortest travel distance and highest utilization of workstation.

Keywords
facility layout design, simulation model, labor productivity, garments manufacturing

1. Introduction

Facilities layout design is one of the key areas, which have significant contribution towards manufacturing productivity in terms of cost and time, in a manufacturing system (Tompkins, 2003). As for government agencies gathering issues and concerns in the garments industry, Garments and Textile Export Board (GTEB) stated that seeing the significant contribution of the garment industry to the millions of the Filipino workers and to the Philippine economy as well, the Philippine government has prepared package assistance for the benefit of the industry, particularly in productivity enhancement, which is one of the assessments that needed to address the issue of low productivity (www.gteb.gov.ph). The current status of the productivity level of garments manufacturing for the basic garments wearable items are significantly low based on recent data from Philippine Statistics Authority (PSA, 2017). Previous studies have proved that this low productivity can be attributed from the following factors: poor facility layout, low average of unfulfilled orders, poor material handling system and improper space utilization (Guoxin, 2008; Aase et al., 2003; Aase et al., 2004; Anucha, 2011).

A study also stated that plant layout and material handling are said to affect productivity and profitability more than most major corporate decisions does. If the production layout is enhanced, the entire company profitability will increase (Meyers 1993).

Other studies also stated that poorly design workstations and facility layout result in unproductive operation, low productivity, and can contribute to ergonomic risk among workers. Therefore, it defeats the goal of the production to streamline the operations achieve overall operational effectiveness of the process (Delgado, 2014).

1.1. Objectives

The main objective of this research study was to provide an improved facility layout in selected garments manufacturing in Metro Manila. It also aimed to determine if plant layout has a significant effect in labor productivity improvement and eventually design an improved facility layout for garments manufacturing in Metro Manila.

2. Methodology

Initially, the researchers have identified factors in the current layout design of the subject company that affects the labor productivity of workers such as processing time, number of workstations, distance traveled and resource utilization. Then these factors were analyzed using different types of layout such as current layout, U-shape layout, P-shape layout, I-shape layout, S-shape layout and J-shape layout. Then the process flow and outputs of these different types of layout design were simulated using SimRunner Option by ProModel software. Results of different layout design were compared in terms of their total output, average processing time, total travel distance of workers, % utilization of workstation and % improvement in labor productivity. The process flow of the methodology is shown in the figure 1 below.

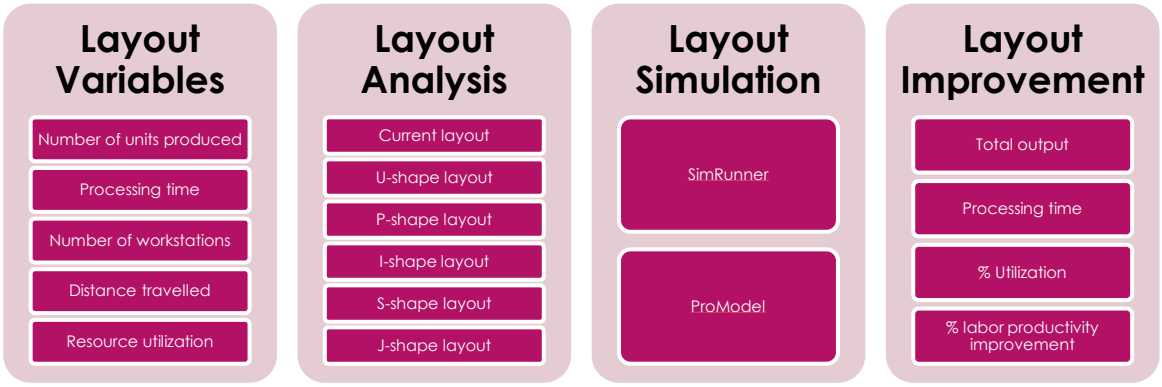


Figure 1. Process Flow of the Methodology

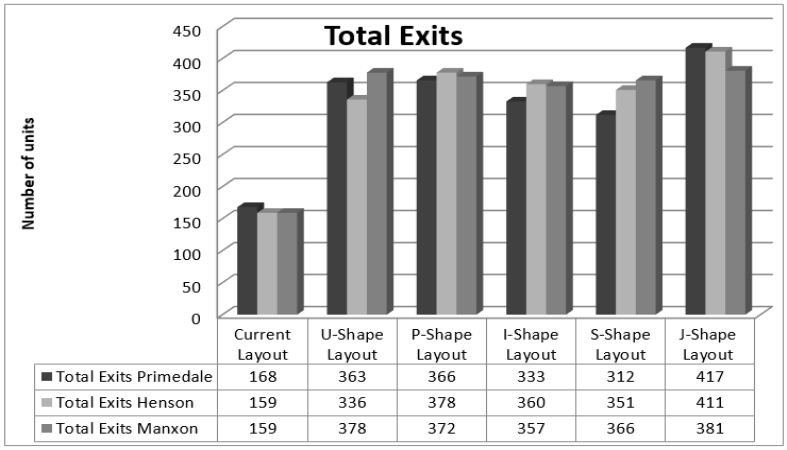
The process model illustrates the framework that uses plant layout simulation in designing an effective facility layout the increase the labor productivity of the subject companies. In every phase there are variables that are needed in the model which are related to process simulations and facility layout designs. In order to test the effectiveness of the methodological design, all data are gathered carefully to achieve an accurate analysis of results.

IE tools were also used in the study to gather data from the layout design such as time and motion study, motion charting and recording, and evaluation using rating factors. During the ocular visit, the researcher also used the opportunity to explore the processes involve inside a garments manufacturing plant.

Then the data that were obtained were used as inputs in the simulation models using SimRunner Option developed by ProModel software. We have used simulation tools to predict and improve the current facility layout system performance of the two subject companies. We wanted to establish the relationships between various system elements within the model such as number of units produced, processing time, number of workstations, total distance travelled and resource utilization. By modeling the actual facility layout in different types like current layout, U-shape layout, P-shape layout, I-shape layout, S-shape layout and J-shape layout, we have conducted what-if analyses to determine the best way to improve system performance thorough optimization of plant efficiency.

3. Results and Discussion

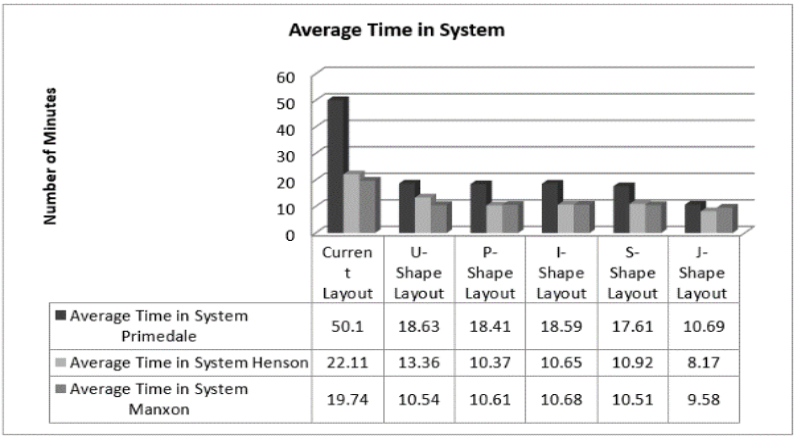
The outcome of the simulation had shown the comparison of the number of units produced using different types of facility layout and design. The result shows that for the 3 subject companies, J-shape layout produced the highest output compared to the other layout design. The summary of result is shown in the figure 2 below.



	Current Layout	U-Shape Layout	P-Shape Layout	I-Shape Layout	S-Shape Layout	J-Shape Layout
Total Exits Primedale	168	363	366	333	312	417
Total Exits Henson	159	336	378	360	351	411
Total Exits Manxon	159	378	372	357	366	381

Figure 2. Promodel Simulation Results for overall Total Exits

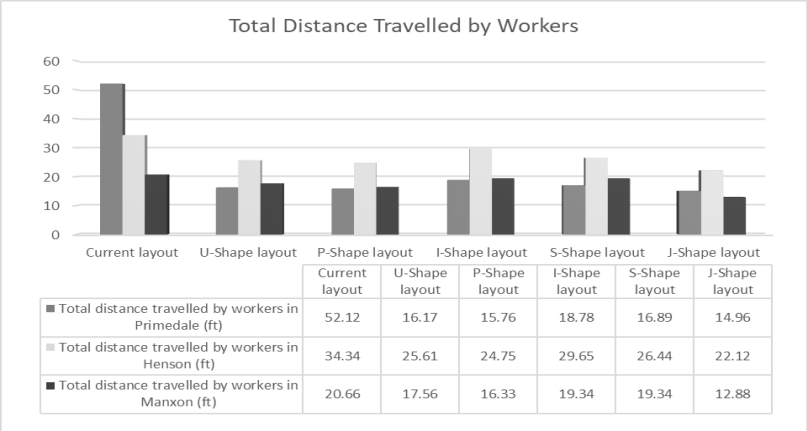
In terms of the comparison of processing time, it shows that J-shape layout resulted in the shortest processing time compared to other layout design for all the 3 subject companies. It can be observed that the processing time of the current layout in Company A is the longest since the workstation location of current layout is too far from each other. The summary of result is shown in the figure 3 below.



	Current Layout	U-Shape Layout	P-Shape Layout	I-Shape Layout	S-Shape Layout	J-Shape Layout
Average Time in System Primedale	50.1	18.63	18.41	18.59	17.61	10.69
Average Time in System Henson	22.11	13.36	10.37	10.65	10.92	8.17
Average Time in System Manxon	19.74	10.54	10.61	10.68	10.51	9.58

Figure 3. Promodel Simulation Results for overall Average Time in the System

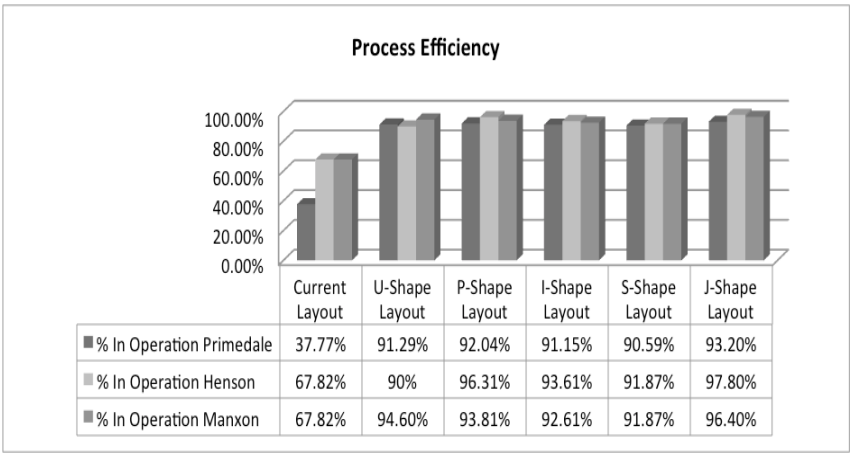
For the comparison of total distance travelled by worker, it was also proved that J shape layout resulted in the shortest travel distance compared to other layout models for all the subject companies. In here it clearly showed the minimization of the distance travelled by workers or material handlers that transports raw materials to different departments or sections in the garments manufacturing site. The minimization of the distance to the three garments manufacturers are based on the simulated layout design models in which the rearrangement of departments and minimization of number of workstation and distance to different area or departments It showed that J-Layout is the most optimal design model of having the highest decreased in distance travel. However, it can be observed the travel distance of Company A is the longest since the workstation location of current layout is too far from each other. The summary of result is shown in the figure 4 below.



	Current layout	U-Shape layout	P-Shape layout	I-Shape layout	S-Shape layout	J-Shape layout
Total distance travelled by workers in Primedale (ft)	52.12	16.17	15.76	18.78	16.89	14.96
Total distance travelled by workers in Henson (ft)	34.34	25.61	24.75	29.65	26.44	22.12
Total distance travelled by workers in Manxon (ft)	20.66	17.56	16.33	19.34	19.34	12.88

Figure 4. Promodel Simulation Results for Total Distance Travelled (ft)

In terms of the process efficiency comparison between the 3 subject companies, it also proves that J-shape layout yielded the highest efficiency compared to other layout design, this is because flow of materials and process in this the design model is very flexible and highly convenient for all subject companies. The summary of result is shown in the figure 5 below.



	Current Layout	U-Shape Layout	P-Shape Layout	I-Shape Layout	S-Shape Layout	J-Shape Layout
% In Operation Primedale	37.77%	91.29%	92.04%	91.15%	90.59%	93.20%
% In Operation Henson	67.82%	90%	96.31%	93.61%	91.87%	97.80%
% In Operation Manxon	67.82%	94.60%	93.81%	92.61%	91.87%	96.40%

Figure 5. Promodel Simulation Results for Process Efficiency

Finally, the different layout design models were compared in terms of % improvement in labor productivity, it shows that J-shape layout yielded the highest % improvement of 95.8%. This is because the J-shape layout model was able to improve the utilization of different processes such as sewing, trimming, ironing, finishing and bundling section compared to other simulated layout models. The summary of result is shown in the figure 6 below.

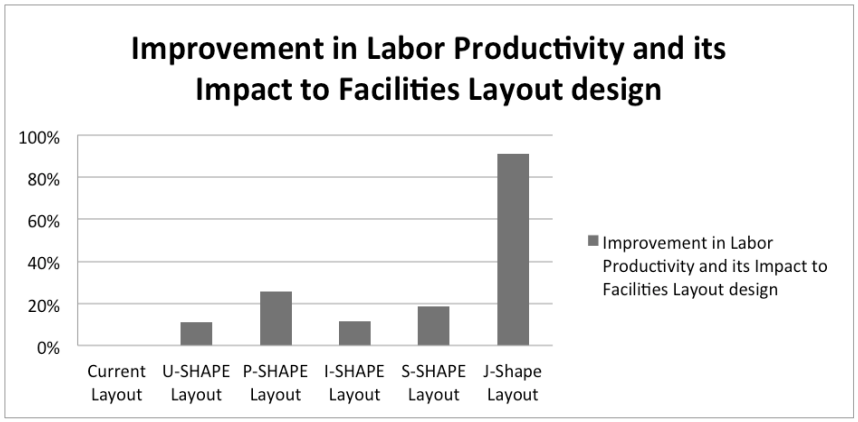


Figure 5. Promodel Simulation Results for % Improvement in Labor Productivity

Based on the result gathered from the analysis, the researchers were able to propose a layout design for the garments company using the J-shape layout model. The figure 6 shows the sample design layout for Company A since this company needed the most improvement in terms of layout design since it has the longest processing time and longest travel distance. However, this layout can also be applied to 2 other subject companies since the processing steps, number of workstations and layout size are almost the same.

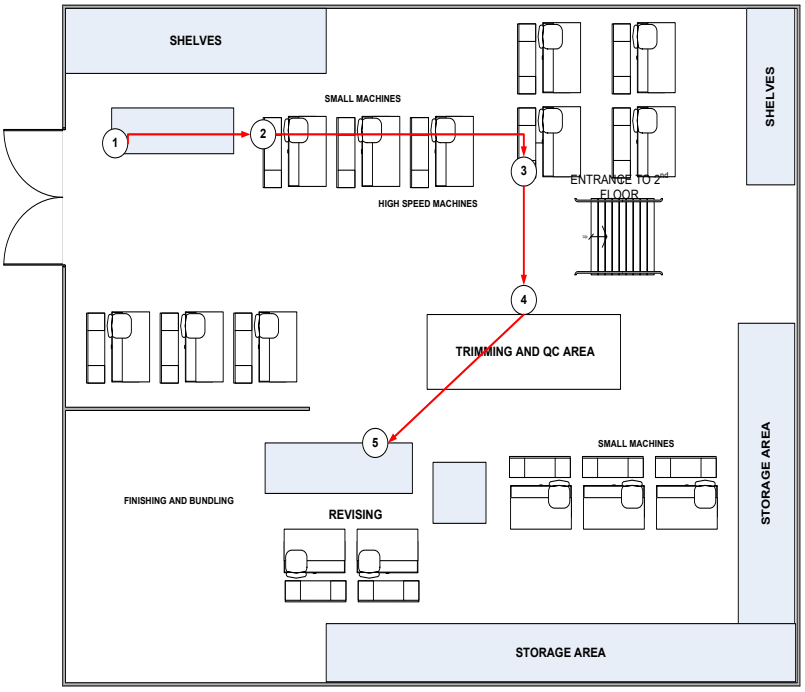


Figure 6. Primedale J-Shape Schematic Layout

4. Conclusion

For the conclusion of the study, using the simulation tools, the researchers were able to compare the results of different layout models for the selected garments company. Design factors were obtained from 3 subject companies in order to determine its effect on labor productivity. Results of different layout design such as current layout, U-shape, P-shape, I-shape, S-shape and J-shape were compared in terms of their total output, average processing time, total travel distance of workers, % utilization of workstation and % improvement in labor productivity. It was proven in the study

that J-shape layout resulted in the highest % improvement of 95.8% in labor productivity and yielded the highest output, shortest processing time, shortest travel distance and highest utilization of workstation.

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Biographies

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