Improvement Printing Industry Plant layout for Effective Production

A. Watanapa*, W. Wiyaratn, and P. Kajondecha

***Abstract*—This research was aimed at planning the layout of the factory and the location of additional machine to increase the productivity based on the systematic layout planning pattern (SLP) to design a virtual model of the factory to meet the maximum requirements of the factory extension. There were 9 models for the layout planning and only one best model would be chosen according to the suitability and the practicalities for the printer. 3 potential models were analyzed and it was found that Model A-3 has become the best one which met most of the practicalities. The working time would be 1.592 hour and the length of work would be 384.618 meters in total.**

***Index Terms*—planning, layout, productivity, systematic, printing.**

I. Introduction

Layout planning is defined as the work or the plan for the installation of machine, tools, devices or other objects required for the production process under the conditions of the structure and the existing building so that the production becomes safe and highly efficient. The layout planning must be conducted with care in order to meet the requirements for the production demands and the production process. The Systematic Layout Planning Pattern (SLP) is an approach based on Analytical Hierarchy Process (AHP) and computer software called Arena. Moreover, there must be a match of balance between production line and delivery line to reduce the transferring time and the waiting time. Some virtual design computer programs are also used such as Arena and Microsoft Visual Basic in relation to the principle in seeking answers in two ways which are CRAFT and Simulated Annealing. This solution will reduce the cost and the waste in production resources so that the area of the factory can be maximized and the working place becomes suitable for the efficiency and the productivity of the factory.

Planning and controlling the productivity is usually aimed at maximizing the use of limited resources and at satisfying the customers. The resources in this context can be defined as all facilities for production such as machine, equipment, labor and raw materials for the production. To maximize the usefulness of the limited resources, the factory managers must be responsible for this and they could work with the department of planning and controlling the productivity to predict, plan, outline, analyze, control the goods in the warehouse, and control the production process. The basics and the technique in controlling production could also be applied in other services such as controlling the goods in the warehouse of the department store when the economic situation reaches a high competition status.

Conform Co., Ltd. is a large-scaled printing house with the registered capital of 150 million Baht. The company receives orders for printed materials and continuous business forms and the company designs as well as prints all kinds of business forms such as continuous papers, standard forms, invoice rolls, coupons, tickets, labels, share papers, confidential envelopes, stickers, code labels, and the like. The company is considered to be one of the leaders in printing business in Thailand. Currently, the company provides service to governmental sectors as well as private sectors including financial institutions and various companies with the likelihood that the company will expand according to the economic situation of the country.

Therefore, Conform Co., Ltd. recognizes the significance of business expansion by increasing the potential of the factory to improve the productivity. As such, the company needs to expand and add additional factory units. For the extra areas, the company need to do a systematic layout planning so the resources such as machine, devices, tools and objects could be installed to meet the production process and the flow of the factory so that the productivity could be maximized. The company needs to install 7 more printers to increase the productivity. By doing so, the company needs to do a new layout planning to expand the area and to increase the productivity. This would improve the printing industry and enhance the income of the nation.

II. Research Methodology

This research would follow the procedure.

1. The data about the new factory plan were collected. The existing area for the new layout was 1,322.94 square meters in size and its shape was shown below.
2. There are 7 more printers to be installed. These are 4 four-color offset printers and 3 five-color offset printer. One more paper cutter is also needed. Each machine has its own requirements about the size and the working space. Moreover, the flow and the delivery of the materials are not similar.

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3. The pathway in the new factory layout must meet the standard size which is 2.5 – 3 meters.

4. The data would be analyzed according to a) the new layout planning in which printers and paper cutter would be moved without taking into consideration the cost of moving them as well as the cost of building and designed the extra space; b) the design of storage area for the raw materials within the factory site.

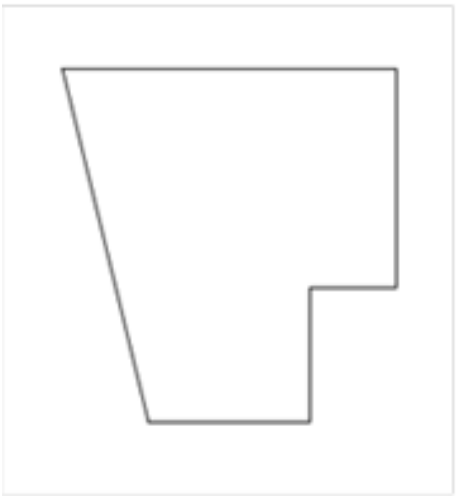

Fig. 1. Intended area for expansion

III. Gathering and Examining the Data from the Site

The researchers got into the site of Conform Co., Ltd. to gather the data about the factory as well as the old layout planning to do a new layout planning. The data provided will be useful for the modification of the layout planning, the requirements for the size and the considerations for the limitations and areas for the machine to be installed. Other issues include the size and the number of the production machine, the amount and the required space for storage, the size and the direction of the pathway for delivery of raw materials and products, the existing space for machine and tools for delivery. The data used in this research would be based on the Systematic Layout Planning pattern (SLP)

IV. Problem Analysis According to the Data

When the relevant data were gathered, the next step was to analyze the problems which occurred to the layout planning and the production line. Afterwards, an approach to the layout planning would be adopted to solve such problems.

V. Evaluation and Summary

The evaluation was made by comparing the existing factory layout planning with the new one proposed by the researchers according to the SLP technique. The data would be compared to do a new layout planning to expand the factory of Conform Co., Ltd.

A. Research Results

The production of goods by Conform Co., Ltd. is usually made to order by customers. In other words, the production system is a Make-to-Order approach and after the production process ends (Fig. 2), the products will be shipped to the customers immediately. In the production process, the steps will follow the Double Stage Processing procedure in which each manufacturing machine would work independently, namely, each product will be made continuously until it is finished within only one machine. At the present time, Conform Co., Ltd. had a limited space but the number of orders has increased. Due to the increasing number of orders, the production could not meet the demands and the time required by the customers. The factory layout planning, therefore, seems to be a good solution so that the company could improve the production procedure and that the products could meet the demands and the deadline as required by the customers. The area and the plan need to be mapped out so that it is suitable to the production process. The flow of the production must be systematic and the delivery must be convenient. With the current area, however, it is impossible; hence, the need for a layout planning.

The company usually produces the goods based on a Make-to-Order approach. For the production, the item would be passed from one machine to the other. There were two types of printers: four-color printers and five-color printers. The production flow chart and the operation process chart are shown below (Figs. 3 and 4).

During the time of research, Conform Co., Ltd., installed

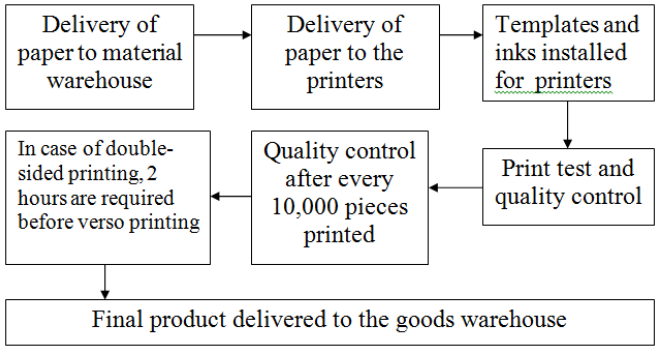

Fig. 2. Printing Procedure

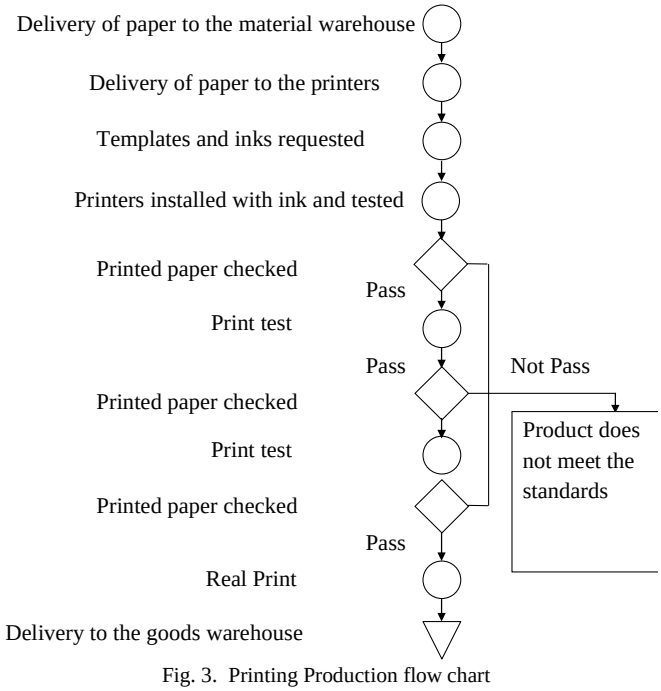

Fig. 3. Printing Production flow chart

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their machines according to the process layout planning. This means that the large machines were installed and fixed at a particular place. Around the same area of the printer, there were also other departments to share the area which included the area for color and template storage, the area for paper sheet preparation before feeding into the printer, the

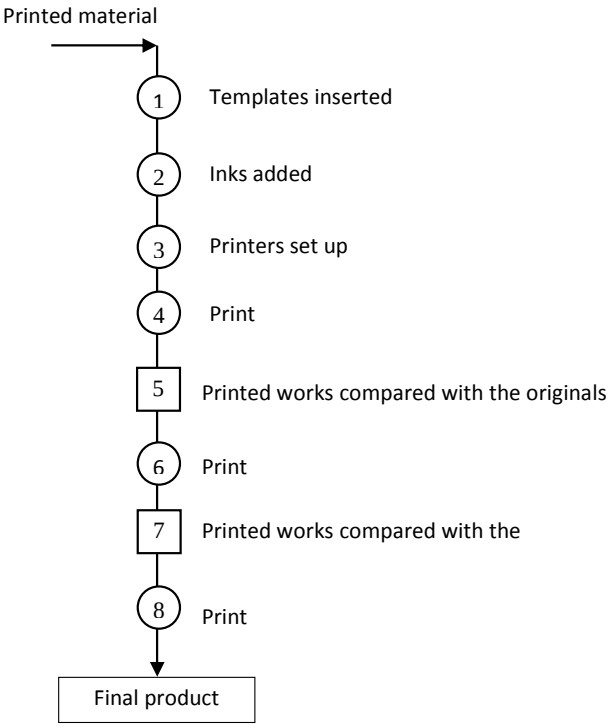

Fig. 4. Operation Process Chart

area for storing the printed papers and the area for delivery of the final products. To expand the area in this research, the company had a plan to install 3 more four-color printers and 4 more five-color printers for the production line which would emerge as a new line within the factory.

VI. Results from Data Analysis

According to the layout planning of Conform Co., Ltd. (see Fig. 5), the expansion of the area within the factory to increase the productivity included the following issues:

The company would install 7 more machines along with the area expansion. This means that the layout must be convenient for delivery and suitable for storage. Each machine would work independently so that the work could be completed in one machine. The layout planning would focus on the delivery of raw materials and the final products so that the time for these processes would be kept to the minimum. Then, the From-To-Chart, Activity, Relationship was drawn up in order to modify the design of the layout planning according to the SLP pattern. It was found that activities A, B and E referred to the department of material warehouse, the department of printer and the department of goods warehouse, respectively. These activities were closely related to one another. As for activities D and C, which referred to the department of cutting and the department of quality control, they were closely related to each other.

According to Fig. 6 of the redesigned layout planning (Model 1.1) and Fig. 7 which is another redesigned layout planning (Model A-1) in 3D format, there would be a gate for a forklift vehicle to enter and exit for delivery purpose. The forklift vehicle could only run to the paper warehouse and then inside the area, another handlift vehicle would deliver items or goods. In this particular layout planning, the goods warehouse and the material warehouse would be situated far from each other but the printers would be closely

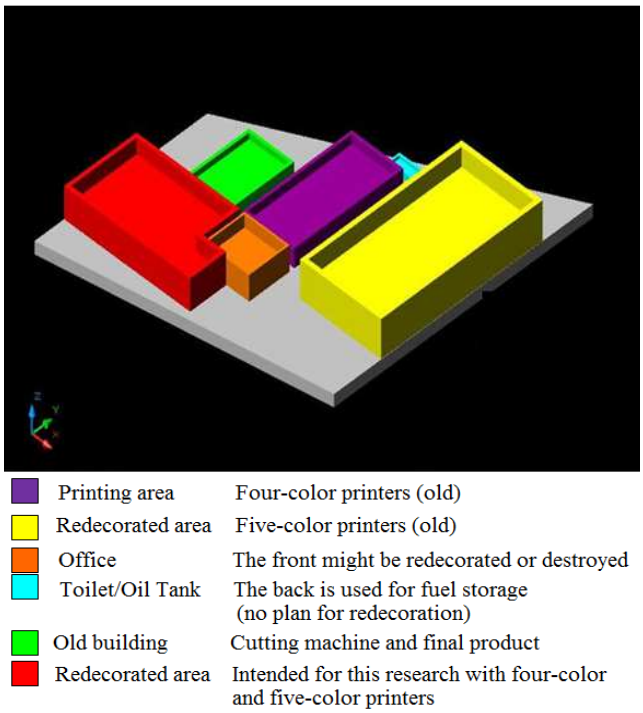

Fig. 5. Current Layout Planning in 3D

installed so that the delivery of paper from the material warehouse to the printers could be done easily. Moreover, the delivery of paper from the printers to the goods warehouse would not be too far. The cutting machine would not be far away from the goods warehouse and therefore the delivery of paper from the goods warehouse to the cutting machine would be very convenient.

According to Fig. 8 of this redesigned layout planning (Model A-2) and Fig. 9 of the layout planning (Model A-2) in 3D format, the goods warehouse and the material warehouse would be closely situated so that the production procedure could be operated continuously. In other words, when the paper is delivered out of the material warehouse to the printers, the paper could be delivered to the goods warehouse straightaway according to the production process. The cutting machine which is situated near the goods warehouse means that it is convenient to cut the papers. The handlift vehicle could deliver the paper out of the printers to the goods warehouse and then the forklift vehicle could deliver the paper inside and outside the material warehouse and the goods warehouse.

According to Fig. 10 of the redesigned layout planning (Model 1.3) and Fig. 11 of the layout planning (Model A-3) in 3D format, the forklift vehicle could enter and exit the printer area. The printers would be situated near the material warehouse and the goods warehouse. Therefore, the paper could be delivered out of the material warehouse to the printers using the forklift vehicle. There would be space to store goods or papers but the area of the material warehouse and the area of the goods warehouse would be smaller in size, compared to Models A-1 and A2. The cutting machine

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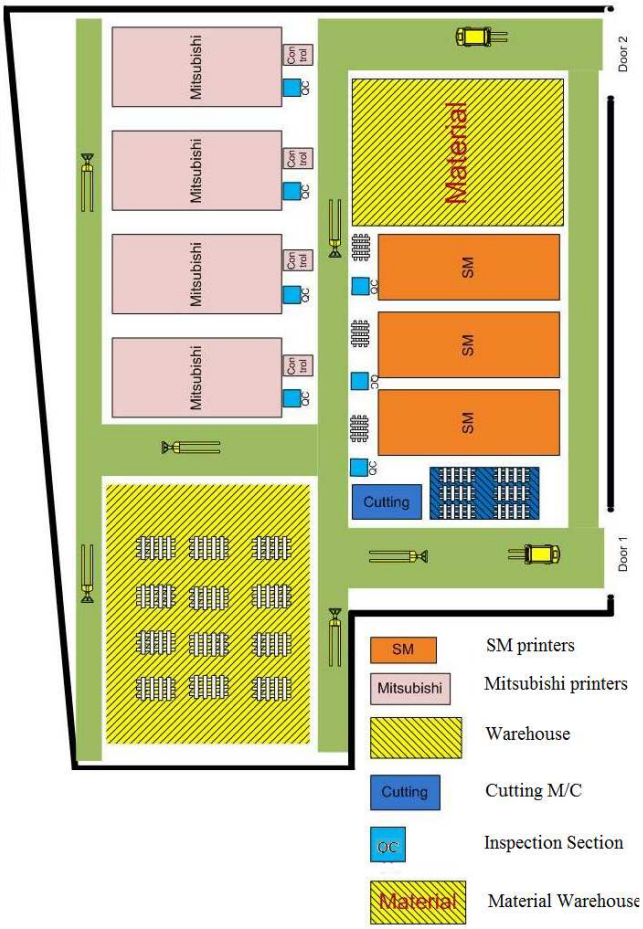

Fig. 6. Redesigned Layout Planning (Model 1.1)

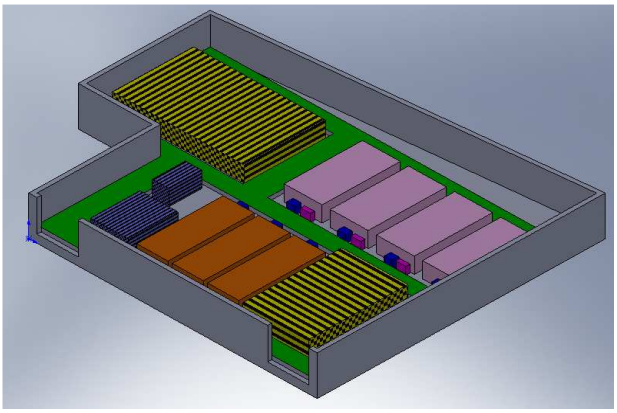

Fig. 7. Redesigned Layout Planning (Model 1.1) in 3D format

would be situated near the goods warehouse so that it is convenient to cut papers.

VII. Conclusion

After the layout planning for the factory had been done with 3 new models, it was found that Model A-1 could be operated within 5743.08 seconds for the length of 392.43 meters. Model A-2 could be operated within 5749.92 seconds with the length of 398.22 meters. Model A-3 could be operated within 5733.00 seconds with the length of 384.618 meters, or with the least time and the least distance. Therefore, Model A-3 would be the most suitable model for the new layout planning of the factory because it could reduce the time and the length of the operation.

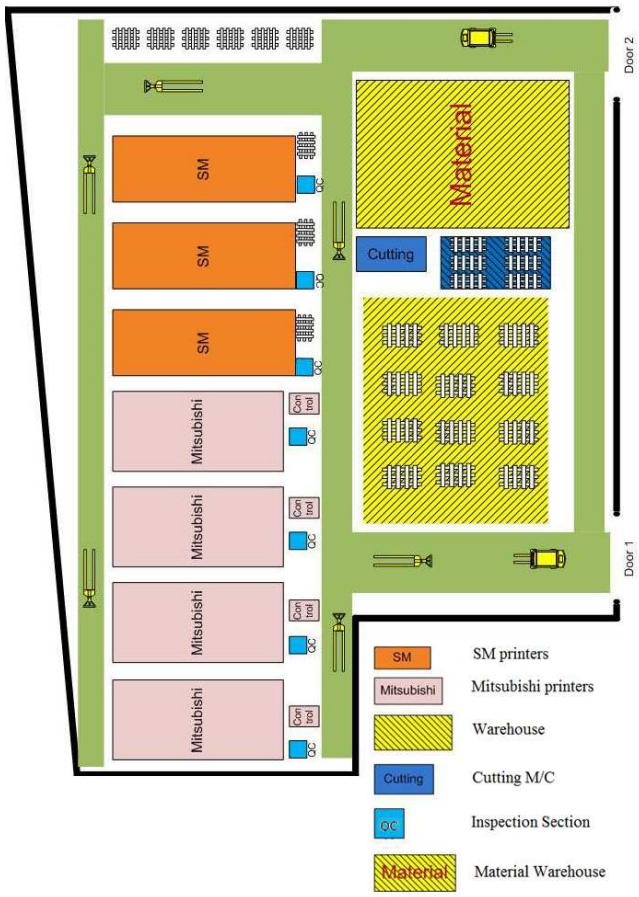

Fig. 8. Redesigned Layout Planning (Model A-2)

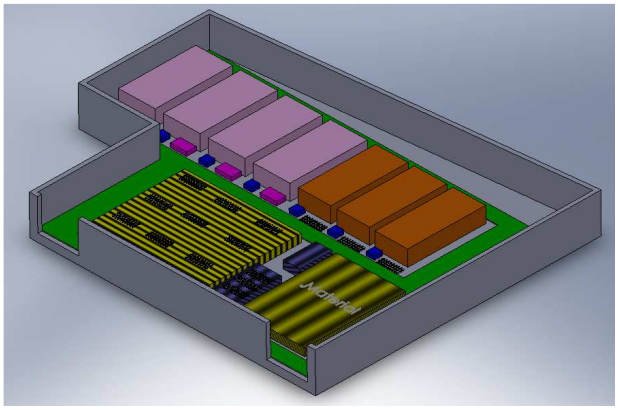

Fig. 9. Redesigned Layout Planning (Model A-2) in 3D format

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REFERENCES

[1] S. Treesat, Factory Design and Layout Planning, 21st imprint, Bangkok: Technology Promotion Assocation (Thailand-Japan), 2009.

[2] C. Srisuphinanon, Factory Design for Productive Optimization (Revised Edition), 1st imprint, Bangkok: I-Group Press, 2009.

[3] R. Phisatpet, Model Design Using Arena Software, 1st imprint, Bangkok: SE-EDUCATION, 2008.

[4] A.J. Geis, Printing Plant Layout and Facility Design, 2nd ed., Pittsburgh: Gradphic Arts Technical Foundation, 2008.

[5] T. Sujaritkul, A Study into the Possibility and the Layout Planning of Aluminium Factory: A Case Study at Sathien Plastics and Fiber Co., Ltd., an undergraduate project for Bachelor of Engineering, Faculty of Engineering, Thammasat University, 1999.

[6] M. Khansuwan, A Study into the Factory Expansion: A Case Study at Kritsab Mechanics Co., Ltd., an undergraduate project for Bachelor of Engineering, Faculty of Engineering, Thammasat University, 1999.

[7] C. Taetongjit, A Simulation of Problem Case at Industrial Factory, an undergraduate project for Bachelor of Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi, 2005.

[8] J. Simcharoen, Improving the Efficiency of Production Line in Cosmetic Factory by Modifying Layout Planning and Balancing Proudction Line, an undergraduate project for Bachelor of Engineering, Faculty of Engineering, Eastern Asia University.

[9] S. Ngamloetporchit, Modifying Factory Layout Planning to Increase Productivity: 113 Case Studies at Jewellery Carton Factory, an undergraduate project for Bachelor of Engineering, Faculty of Engineering, Mahanakorn University of Technology, 2007.

[10] R. Tangpao, An Analysis of Choice for Factory Layout Planning: A Case Study at Air-Conditioner Assembly Factory, an undergraduate project for Bachelor of Engineering, Faculty of Engineering, Chulalongkorn University, 2008.

[11] S. Uea-areemit, Improving Factory Layout Planning by Using Virtual Situation: A Case Study at Attire Factory, an undergraduate project for Bachelor of Engineering, Faculty of Engineering, Chulalongkorn University, 2008.

[12] S. Wikolkasem, The Development of Program for Layout Planning, an undergraduate project for Bachelor of Engineering, Faculty of Engineering, Chiang Mai University, 2008.

[13] N. Somsuk, Improving Layout Planning to Increase Productivity in Furniture Manufacturing Procedure, an undergraduate project for Bachelor of Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi, 2008.

[14] S. Tantrakul, Redesigning FAcotyr: A Case Study at an Automobile Part Manufacturer, an undergraduate project for Bachelor of Engineering, Faculty of Engineering, Chulalongkorn University, 2000.

[15] K. Pholpibulsuntorn, Improving the Production Procedure of Food Packaging Manufacture, King Mongkut's Institute of Technology North Bangkok, 1994.

[16] A. Tiranasawat, Designing Template Production Line, an undergraduate project for Bachelor of Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi, 2003.

[17] A. Patthawaro, Program for Layout Planning According to Moleculre Structure and Behavioral Procedure, an undergraduate project for Bachelor of Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi, 2003.

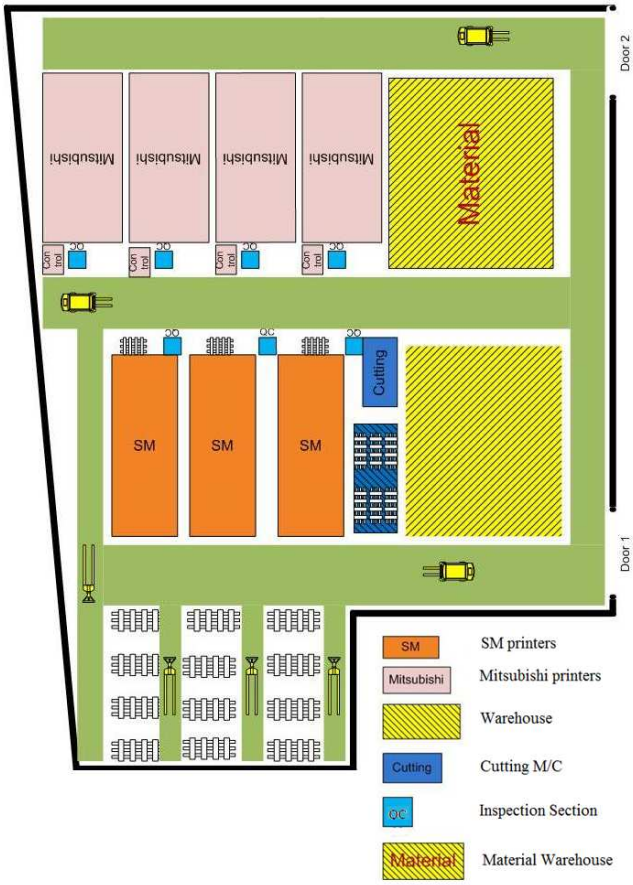

Fig. 10. Redesigned Layout Planning (Model A-3)

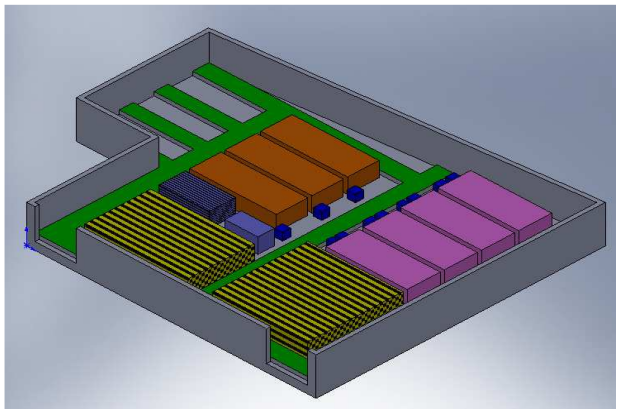

Fig.11. Redesigned Layout Planning (Model A-3) in 3D format

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