

Performance Enhancement in a Print Pack Firm by Layout Optimization

S.Ambika

Asst. Professor

Department of Printing Technology

Avinashilingam Institute For Home Science and Higher Education For Women, University, Coimbatore,

Tamil Nadu, India

D.Vasanth Kumar

Asst. Professor

Department of Mechanical Engineering

Jansons Institute of Technology, Coimbatore, Tamil Nadu, India

Abstract- this paper presents the application of simulation software Arena and layout optimization software Plan Opt to a dynamic print and packaging company in India, Coimbatore. Some of the problems expressed by the company were large and unnecessary volume of shop floor material handling cost, difficulties and confusion over production planning, long products lead times resulting in losing customers and high overhead costs because of poor layout of machinery and the lack of proper aisle structures for movement of the lift-trucks. This paper shows the process of developing few final optimum layout designs by providing the management with multiple layout configurations and showing the impact of each design on the material handling cost at each stage. These solutions are also simulated to see the impact of the change in the layout of the company.

Keywords – Simulation, optimum layout, Packaging Industry.

I. INTRODUCTION

The printing and packaging industry in India has assumed growing significance during last decade. The printing industry is one of the biggest and fastest growing sectors in India. Conservatively speaking, we have more than 1,50,000 printing presses actively in operation all over India, with a capital investment of over Rs.83,000 million. This industry provides employment to about 1.5 million people directly or indirectly. The print pack company which is in our topic is one of the major player in the city, but the major difficulty faced by the company is the unplanned layout. We try to give solution for the problems. The existing layout models is that they normally generate a single take it or leave it layout design. Layout Optimization is one of the top issues for any industry. But by using this VIP-planopt software (Engineering optimization software) is a powerful general-purpose Facility Layout Optimization software for engineers, industrial planners. While it has a host of capabilities for solving large real-world industrial facility layout designs problems. Optimal layouts reduce materials handling costs, help streamline all operations in a facility, and reduce energy bills. Arena simulation software helps to simulate the selected optimized layout to demonstrate, predict, and measure system strategies for effective, efficient and optimized performance. The following paper describes about the application of these software in a print pack firm and he enhancement of the firm's performance.

II. COMPANY'S PROFILE

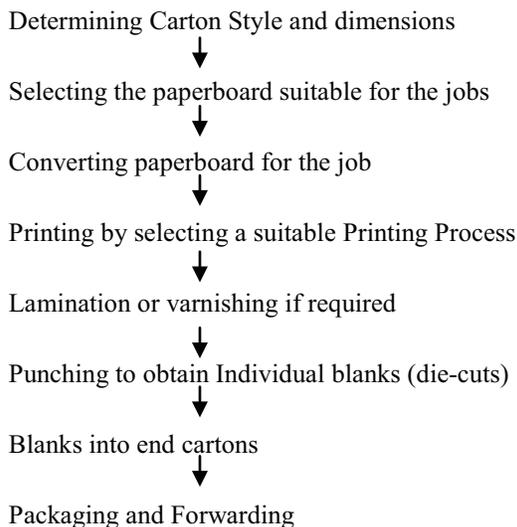
A. The print pack firm, in this study is a major and dynamic producer of a diverse range of print pack products in Coimbatore. It has been in operation for more than 15 years. The company specialises in a wide range of print pack products including all special finishing operation. Apart from producing packing carton it also specializes in producing different process printing including sheetfed offset printing, flexography printing and screen printing. Furthermore the company has a set of 2 cutting machines, die cutting machines, U.V curing machines, laminating machines, stapling machines, folding machines and gluing machines. The company is the major supplier to many consumer products.

B. Background- The growth of operations and increase in the number of work-centres over the last 15 years has resulted in an inefficient shop floor layout with a large number of unnecessary material movements. This difficulty arises almost with every growing company and worsens over time. The company normally started with one or two work-centres and as they grow, they introduced new work-centres on the shop floor without considering the impact of material movements or other layout considerations such as ease of material handling on the total operation of the company. In many cases the location of a new work-centre is dictated by other work-centres which already exist on the shop floor. The following represents some of the major difficulties experienced by the company:

- Increase in the number of accidents and injuries on the shop floor caused by poor layout of machinery and the lack of proper aisles for movement of the lift-trucks.
- Growing cost due to unnecessary large volumes of material handling.
- Huge amounts of work in process and finished products.
- Confusion over production planning.
- Losing customers due to long lead times and high overheads.
- Increase in the waste of finished products.

The management of the company was interested to explore the benefits of optimized layout in order to overcome these difficulties. In particular, the company was keen to evaluate performance measures such as travelling cost and safety of the existing layout configuration and compare such measures with the possible solutions generated by the layout design model.

III. A.WORK FLOW- FROM PROCESS TO PRODUCT:



The work flow starts with the customer requirement of the required carton. It starts with the designing of the shape size etc., which is done by the designing software like Adobe illustrator, Corel draw and Photoshop etc., the designed soft copy is converted as an image carrier by the image processing station according to the requirement of the final printing process. Then a required printing process is chosen considering the need of the final customer. From the store house the required cardboard of specified thickness of paper is chosen. Planning to the size using the cutting machine the board is converted according to the job specified. Then printing is carried over according to the schedule. The next step is to go for the finishing process to add on value to the product. There are many value adding process one of which is properly selected, which may be like laminating process, UV-curing process etc., the next step is proceeded to give the carton the final required shape using die-cutting machine proceeded on with the gluing operation and finally it is packed to forward.

B. PRECEDENCE DIAGRAM:

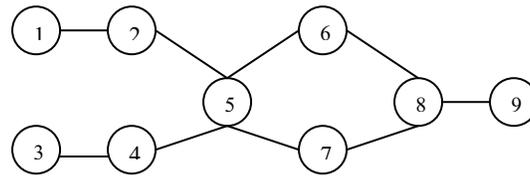


Fig 1- Work flow of the firm

1. Designing Unit
2. Image Processing Unit
3. Paper storing Unit
4. Cutting Unit
5. Printing Unit
6. Lamination /U.V curing Unit
7. Die-cutting Unit
8. Finishing and processing Unit
9. packing and forwarding Unit

Facility layout has profound effects on the organizational productivity and profitability. It is estimated that about 20-50% of operating costs in manufacturing relates to materials handling, a factor highly correlated to the quality of the facility layout design. Superior facility layouts reduce materials handling costs, help streamline all operations, and reduce energy bills. Consequently, layout design remains an important issue for industrial facility planners with significant potential for research.

IV. FACILITIES USED:

A. VIP-PLANOPT

B. Arena simulation software

- A. vip-planopt: Layout Optimization is one of the top issues for industrial facility planners. It has profound effects on organizational productivity and profitability. Optimal layouts reduce materials handling costs, help streamline all operations in a facility, and reduce energy bills. VIP-PLANOPT (Visually Interfaced Package of PLANOPT) gives you the best possible layouts for your real-world problems with its robust hybrid proprietary [optimization algorithm](#). It is a powerful general-purpose facility layout optimization software and at the same time serves as an excellent teaching and research aid. VIP-PLANOPT can optimize with "Hard" modules that may be movable or "Anchored". "Hard" module option allows the user to specify the exact dimensions (width and length) required for ideal functioning of a department. VIP-PLANOPT produces optimized layouts maintaining exactly the user-specified dimensions while keeping "Anchored" modules strictly at the user-specified locations.

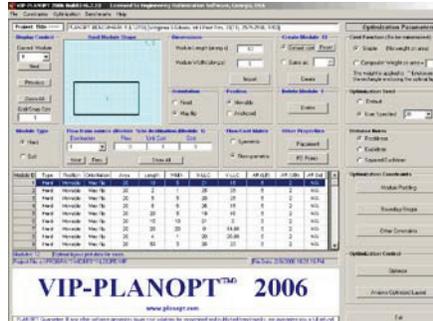


Fig 2. VIP-PLANOPT-Layout optimization

B. *ARENA SIMULATION SOFTWARE*: Arena is a discrete event simulation software [simulation](#) and [automation](#) software developed by Systems Modeling and acquired by Rockwell Automation. In Arena, the user builds an experiment model by placing modules (boxes of different shapes) that represent processes or logic. A connector line is used to join these modules together and specifies the flow of entities. While modules have specific actions relative to entities, flow, and timing, the precise representation of each module and entity relative to real-life objects is subject to the modeler. Statistical data, such as cycle time and WIP (work in process) levels, can be recorded and outputted as reports. The Arena modeling system from Systems Modeling Corporation is a flexible and powerful tool that allows analysts to create animated simulation models that accurately represent virtually any system. Arena employs an object-oriented design for entirely graphical model development. Simulation analysts place graphical objects—called modules—on a layout in order to define system components such as machines, operators, and material handling devices. Arena is built on the SIMAN simulation language. After creating a simulation model graphically, Arena automatically generates the underlying SIMAN model used to perform simulation runs. The graphical modules used by simulation analysts to create models are provided “off-the-shelf” with Arena. These modules can also be custom designed by the end user to produce a modeling environment that is tailored to a specific application area (e.g., welding, cross-dock, etc.).

V. EXISTING LAYOUT DESIGNS:

In the first few visits to the company the severity of the problems expressed by the management was confirmed were then focused at collecting the information required for giving optimized layout. The company requires that certain work-centres must not be relocated as special operational environment were in use for these stations. Any relocation of such work-centres implied that new and costly environments must be re-installed. Furthermore, some of the work-centres also have to be close to each other as they are using the same facilities.

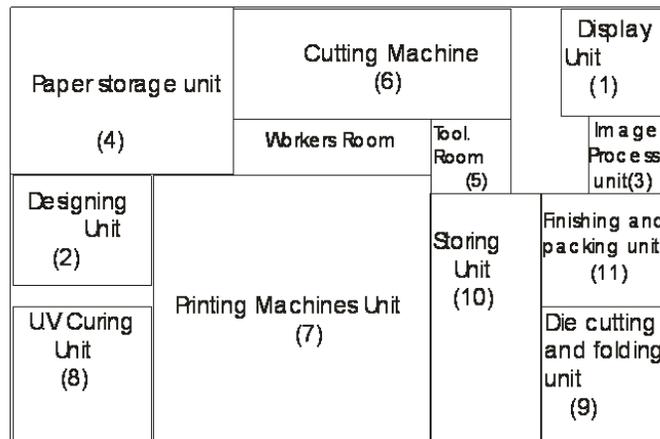


Fig 3. Existing Layout Design

1. Display Section

2. Designing Unit
3. Image processing Unit
4. Paper storage unit
5. Tool room
6. Cutting Machine Unit
7. Production department
8. Lamination Unit
9. Die-cutting and folding unit
10. Storing Unit
11. Finishing and Packing Unit

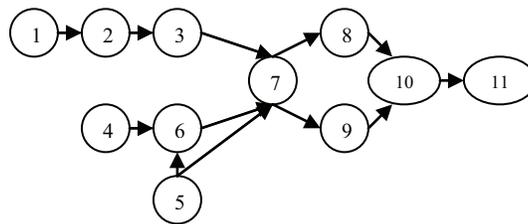


Fig 4. Precedence diagram-Existing

VI. PROPOSED LAYOUT:

DISTANCE NORMS:

Squared Euclidean Norm-

Squared Euclidean Norm- The distance d_{ij} between two points, using this norm, is the square of the Euclidean norm distance. $d_{ij} = (x_i - x_j)^2 + (y_i - y_j)^2$.

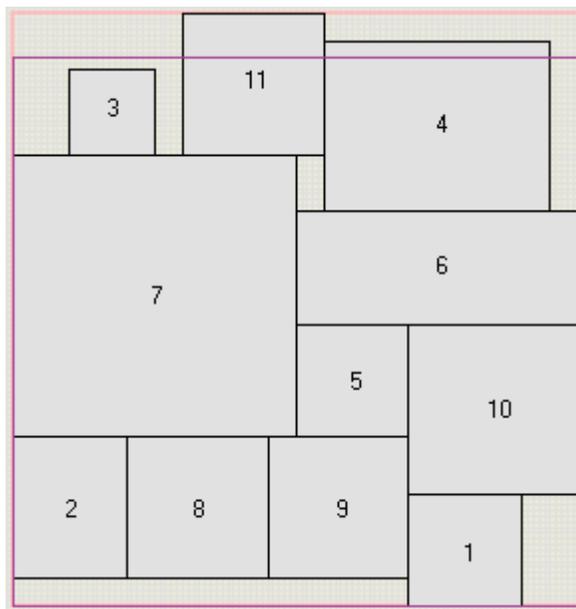


Fig 5. Proposed Layout using optimization software- Squared Euclidean Norm

Rectilinear Norm

It is also called Manhattan distance norm. The distance d_{ij} between two points using this norm is the sum of rectilinear distances along x and y axes. $d_{ij} = |x_i - x_j| + |y_i - y_j|$

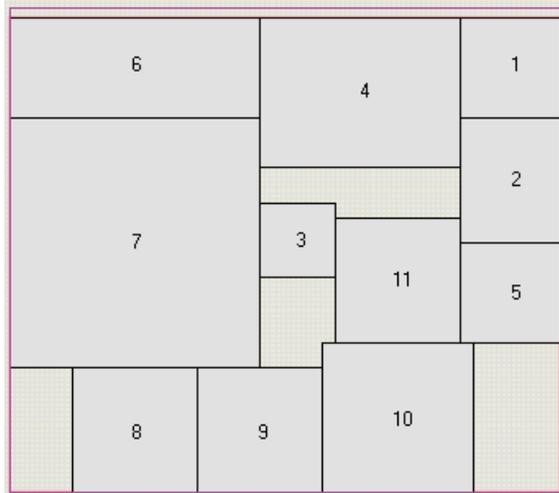


Fig 6. Proposed Layout using optimization software- Rectilinear Norm

Euclidean Norm

The distance d_{ij} between two points, using this norm, is the shortest distance made by a straight line drawn between the two points $d_{ij} = ((x_i - x_j)^2 + (y_i - y_j)^2)^{1/2}$

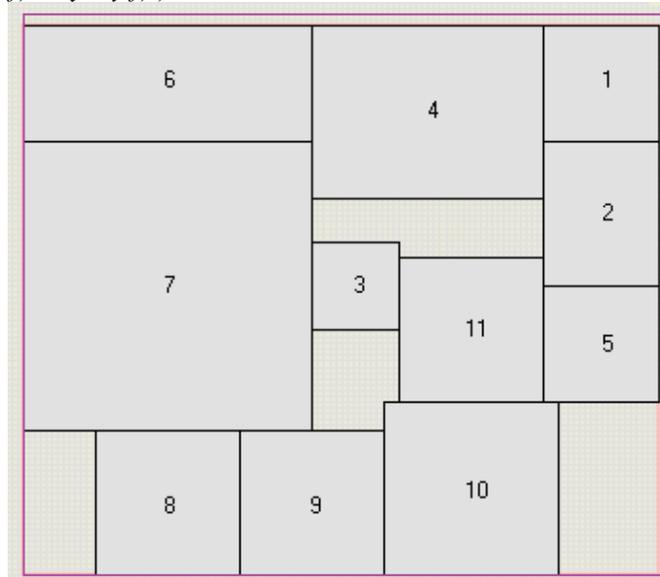


Fig 6. Proposed Layout using optimization software- Euclidean Norm

VII. TRANSFER TIME COMPARISON:

Existing Layout

2 → 3 - 100 secs
 4 → 6 - 30 secs
 6 → 7 - 70 secs
 3 → 7 - 50 secs
 5 → 6 - 15 secs
 5 → 7 - 15 secs
 7 → 8 - 20 secs
 7 → 9 - 40 secs
 8 → 10 - 50 secs
 9 → 10 - 50 secs
 10 → 11 - 20 secs

Optimized Layout

2 → 3 - 50 secs
 4 → 6 - 30 secs
 6 → 7 - 20 secs
 3 → 7 - 50 secs
 5 → 6 - 15 secs
 5 → 7 - 15 secs
 7 → 8 - 20 secs
 7 → 9 - 40 secs
 8 → 10 - 75 secs
 9 → 10 - 50 secs
 10 → 11 - 50 secs

Simulation done using Arena simulation software

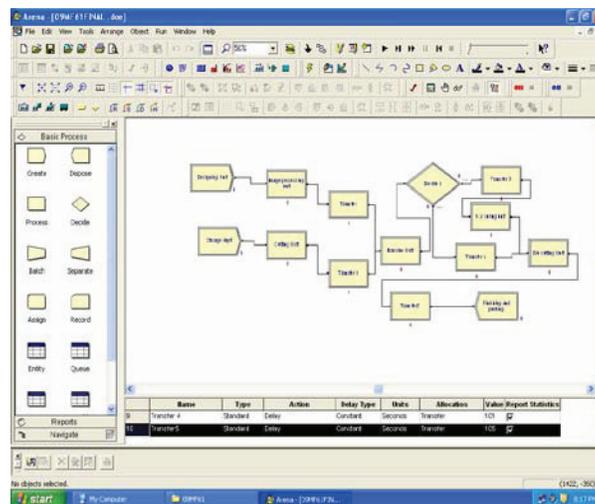


Fig.7-Transfer time calculation of the proposed layout using simulation software

Some of the expected benefits through the final designs are:

- safe working environment,
- 30% reduced material handling cost,
- reduced number of lift-trucks needed,
- increased employees efficiency,

VIII. CONCLUSION

Facility layout has great effects on the organizational productivity. It is estimated that about 20-50% of operating costs in manufacturing relates to materials handling, a factor highly correlated to the quality of the facility layout design. Superior facility layouts reduce materials handling costs, help streamline all operations, and reduce energy

bills. Consequently, layout design remains an important issue for industrial facility planners with significant potential for research. Thus by making an optimized layout using the VIP Planopt software we are able to reduce the material movement and thus increase in productivity.

REFERENCES

- [1] Bo Li, Shreyes N. Melkote "Improved work piece location accuracy through fixture layout optimization", International Journal of Machine Tools and Manufacture, Vol 39, Issue 6 June 1999, Pages 871-883.
- [2] Bartholdi, J.J. (1993). Balancing two-sided assembly lines: A case study, International Journal of Production Research, Vol. 31, No.10, pp. 2447-2461
- [3] Baybars, I. (1986). A survey of exact algorithms for simple assembly line balancing problem, Management Science, Vol. 32, No. 8, pp. 909-932
- [4] Erel, E., Sarin S.C. (1998). A survey of the assembly line balancing procedures, Production Planning and Control, Vol. 9, No. 5, pp. 414-434
- [5] Fonseca D.J., Guest C.L., Elam M., Karr C.L. (2005). A fuzzy logic approach to assembly line balancing, Mathware & Soft Computing, Vol. 12, pp. 57-74
- [6] Grzechca W. (2008) Two-sided assembly line. Estimation of final results. Proceedings of the Fifth International Conference on Informatics in Control, Automation and Robotics ICINCO 2008, Final book of Abstracts and Proceedings, Funchal, 11-15 May 2008, pp. 87-88, CD Version ISBN: 978-989-8111-35-7
- [7] Grzechca W. (2010) Structure's Uncertainty of Two-sided Assembly Line Balancing Problem. URPDM 2010 Coimbra, CD version
- [8] Gutjahr, A.L., Neumhauser G.L. (1964). An algorithm for the balancing problem, Management Science, Vol. 11, No. 2, pp. 308-315
- [9] Helgeson W. B., Birnie D. P. (1961). Assembly line balancing using the ranked positional weighting technique, Journal of Industrial Engineering, Vol. 12, pp. 394-398
- [10] Kao, E.P.C. (1976). A preference order dynamic program for stochastic assembly line balancing, Management Science, Vol. 22, No. 10, pp. 1097-1104
- [11] Lee, T.O., Kim Y., Kim Y.K. (2001). Two-sided assembly line balancing to maximize work relatedness and slackness, Computers & Industrial Engineering, Vol. 40, No. 3, pp. 273-292
- [12] Salveson, M.E. (1955). The assembly line balancing problem, Journal of Industrial Engineering, Vol.6, No. 3. pp. 18-25
- [13] Scholl, A. (1999). Balancing and sequencing of assembly line, Physica- Verlag, ISBN 9783790811803, Heidelberg New-York.