Proposal for Improvement of Physical Arrangement in the Productive Sector of a Company of the Graphic Branch

Weverton Abreu Cascais, Marcelo Albuquerque de Oliveira, Gabriela de Mattos Veroneze, and Joaquin Maciel da Costa Craveiro

ABSTRACT

Getting a competitive advantage is the challenge in the current context for companies. Thus, to achieve this result it is necessary to add value to the product or service. This ends up reflecting the way the transforming resources are disposed in the production process, influencing the increase or not in productivity. Most micro and small companies do not have a good management plan, delaying improvements in their production processes, among them the best use of their physical spaces. It may seem simple, however, getting a best use of the space available for a production line ends up becoming a task that usually takes time and costs. Consequently, the main objective of this article is to present, through an on-site case study in a graphic micro-enterprise, a proposal to improve the paper bag production process, allowing for a better reuse of manufacturing flows and reducing the movement of people, products and materials.

Keywords: Layout, Microenterprise, Paper bag, Physical arrangement.

I. INTRODUCTION

One of the biggest challenges found by the factories of small and medium size is their layouts’ adaptation according to the gradual adaptation of the company.

This results in the entrance of new products in the production line process and acquisition of machinery aiming to modernize, guaranteeing the competitiveness, and corresponding to the consumers’ market requirements. In front of this context, it is necessary to look for solutions that improve its physical arrangements positively in its profits.

The layout planning can seem to be simple, although, obtaining the ideal physical disposition is a process that takes time, and is behind an elaborated study, comparing the advantages and consequences generated by the layout change of the process.

Observing the raw-material stream within the process of its formation into finished product, observing that it does not scroll huge distances, eliminating or mitigating activities that do not aggregate any value.

Within this context, the aim of this article is to present a layout allowing better the management of the fabrication and optimization of the stream in the movement of people and materials in the paper bag production of a graphic industry.

For this, it has been done the data collection in loco, allowing to propose improvements about the current layout adopted by the company through the analysis of the map flowchart. In case it is implemented, it can generate many ears to the organizations, like production cycle time reduction and earns of physical space and stream improvement.

II. LITERATURE REVIEW

A. Layout Arrangement

The elaboration of a physical arrangement or a layout consists of defining where to position the machines, equipment and materials participating of the productive process. It is necessary that this decision consider aspects related to the movement, transport, productive capacity, time, raw material stock, and finished product stock (Slack et al., 2008).

With this, the layout can interfere directly in the operations’ productivity capacity, and once the change is done analyzing these crucial spots of the process allow it to generate gains in...
the production through rationalization in the streams of people, materials, and information. The objective of the physical arrangement planning is to define the work stream more efficient from the point of view of the production cost, which results in an enhancement in many other production areas (Slack et al., 2008).

This way, the lack of planning and also of positioning of transformation resources, can impact on the generation of streams excessively longs or confuses, unnecessary materials’ stocks and formation of lines (clients and commodities), costs increase resulting in the delivery’s delay of the requests creating unsatisfactory to the clients.

The products arrangement is the one in which the resources to be transformed are involved in operations order, in which, the materials that get in the transformation follow a fixed stream in the process. The physical arrangements, from a lean perspective, are evaluated in order to identify better flows for production processes (Kurilova-Palisatiene et al., 2018).

This kind of arrangement is normally applied to products’ fabrication activities that dispose of a few varieties and a high production level. In the layout process, the workplaces are aggregated in relation to the function exerted, that is to say, the machines that have similar functions are positioned.

With this, the production does not follow preferably the same operational sequence, because the products produced do not have patterns. The positional physical arrangement, by the name leaves evident that the transformed resources stay fixed or almost permanently in relation to the transformed resources.

The importance of studying physical arrangements is demonstrated in several researchers, from applications in hospitals to classic manufacturing and maintenance processes (Almanei et al., 2017; De Zan et al., 2015; Islam et al., 2019; Lacerda et al., 2016; Narayananmurthy and Gurumurthy, 2017; Velmurugan and Dhingra, 2015; Vilkas et al., 2015).

1) Process Mapping

The process, according to Barnes (1982), it’s a technique to register a process in a concise way, enable best understanding and ease and propose best enhancements.

The map represents plenty of steps or events that occur during the execution of a specific task or during a series of actions. Besides that, it allows eliminating activities that do not aggregate value and shows critical points that are going to be targets of future improvements.

To ease the process analysis techniques of the register is used, such as flow chart and map flow chart (Fantini et al., 2015; Mayr et al., 2018; Narayananmurthy and Gurumurthy, 2017).

2) Flowchart

The flowchart is a tool of a widely spread use that can be applied in the description of a bunch of types of sequential streams, such as an activity’s stream that composes an organizational process or a project, of the materials in a manufacture process, of the instructions that compose a computational algorithm, and of the data that stream in a system, through the symbol’s enchainment, such as a rectangle to represent activities and the lozenge to represent the decision making (Krajewski, 2009).

The activities are represented by symbols developed by ASME (American Society of Mechanical Engineers), enabling the global understanding and compact process of production, whilst it assists in the detection of problems related to losses, wastes, and bottleneck spots, contributing to the search for the solution (Yilmaz and Yazgan, 2018).

The symbols generally used are the ones in Fig. 1.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Activity</th>
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<tbody>
<tr>
<td>✔️</td>
<td>Operation</td>
</tr>
<tr>
<td>▼</td>
<td>Storage</td>
</tr>
<tr>
<td>➔</td>
<td>Transport</td>
</tr>
<tr>
<td>⬤</td>
<td>Delay</td>
</tr>
<tr>
<td>□</td>
<td>Inspection</td>
</tr>
</tbody>
</table>

Fig. 1. Symbols frequently used in the Flowchart.

3) Map Flowchart

The map flowchart has as aim study, with the flowchart, the physical movement within the productive process, besides the available gaps and the localization of workplaces. This represents the movement between the process’s stations disposed in the productive layout, following a sequence (Mayer, 1981).

This way, it allows a graphic representation complete, solid and objective about the process flowchart in the company studied. It is important to the identification of the movement of materials, collaborators and equipment through the productive sectors. Besides that, it can assist in the analysis of the process interpretation, because it offers a general understanding of the whole operations’ functioning, having a general vision of the whole process (Arafeth et al., 2018; Jirasukprasert et al., 2015).

III. METHODOLOGY

A. Study Case Company

The company studied is located in Brazil Avenue – Saint Antônio, in the city of Manaus – AM. Founded in the year of 2000, it has as focus to assist the current demand of the paper bags’ market, fulfilling strict criteria such as quality, competitiveness and environmental responsibility, through the practices of recycling cooperating in partnership with cooperatives to the diminution of losses and wastes.

The manufacturing unit has 20 employees, three in the sales area, three in the administrative/financial area, two in the delivery and 12 connected to the productive process. Nowadays, the organization has a wide diversity of bags with the most varying sizes and shapes of personalization. These are: Bags to the supermarket, clothes bags, packages to wrap snacks, visit cards, jewelry tags within others.

The industry works as a unique throne, during five days per week. It has not been possible to classify all the industry products in question, because of the high variety of bags produced and because of the exclusive personalization of each client. With the data that have been given to us by the company’s administration, we have elaborated a list with the three models that have been most required by the clients during the studied period. The three models with the biggest delivery volume have the same fabrication process, and the final mounting part is manual. The Volume of bags delivered
from the period of 01/08/2020 to 31/12/2020 is presented in Table I.

<table>
<thead>
<tr>
<th>Model</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP005</td>
<td>40584</td>
</tr>
<tr>
<td>SP003</td>
<td>36977</td>
</tr>
<tr>
<td>SP009</td>
<td>35619</td>
</tr>
</tbody>
</table>

B. Description of the Productive Process
The graphic industry of bags provides itself of a variety of products in its portfolio. Therefore, it is going to be described as the effect of comparison to the fabrication stream of products in the process of making the bag model SP005 that has 23 cm of height, 22.5 cm of width and 8.5 cm of side.

These steps are illustrated in the Fig. 2. This stream has been chosen because it aggregates the biggest number of common activities to the company’s products production, rightly by the fact of having a bigger demand.

The productive process starts when the budget to be printed is approved by the client, generating a service order that is forwarded to the pre-printing sector.

The designer responsible for materializes of the customers’ ideas in a digital archive, in which is going to be recorded in known matrices such as planography’s sheets.

The planographic sheets are done by an outsourced company. One of the sheets is engraved it’s done the removal to start the process of bags’ fabrication.

First, it has done the materials’ separation that is going to be used for the printing. It has done a test printing that is retraced to the designer to verify if the colors and hues are according to the clients’ specificities.

Once the printing is finished, the next step is the guillotine where the cuts are done according to the bags’ size, besides doing cuts that are going to compose the background.

The subsequent step is the cut and crease where the printing is prepared and starts having the bags’ shapes to be mounted. After this process, it comes in the manual of the bag, where the folds are going to be done and passed to the process of background collage.

With the glue, drying and passing to the last sector responsible for the drill and saddle stitching of paper bags. With the bag mounted it’s done the product counting and enclosed in equal batches according to required quantity. With the products packaged and identified, they are put in a temporary stock, which awaits to be delivered to the client or its withdrawal by the client. Fig. 3 presents the SP005 bag sequence of fabrication.

IV. RESULTS AND DISCUSSIONS
After describing the SP005 bag fabrication, we have here below the repression of the map flowchart, which it is listed in it the necessary steps for the paper bag fabrication.

A. Description and Analysis of the Current Map Flowchart
After describing the process of manufacturing the paper bag, we have the representation of the flowchart map, as shown in Fig. 4. It lists the steps required for manufacturing the paper bag.

The process orients the physical arrangement presented, because the bag is fabricated with different streams involving the same machinery and high movement of material and product. Each machine has a stock, and they are not planned reasonably, because they do not have a demand predictability that refers to the lack of good production control.

The sectors receive a sheet that serves as a guide to follow the progress of the bags’ fabrication process. In each post that it’s done one step of the process, the responsible must sign informing that the quantity generated is pointed to as possible issues.

It’s observed that the fabrication process can be characterized in batches or batch processing. This is seen while analyzing the particularities in each step of the process: each batch of the process suffers modifications in each specific sector.

Besides being an only model, it can suffer variations related to the volume and variety and with this, it takes time so that the product can be fabricated again, reasonably because of the particularities of each client, it ends being characterized as an intermittent production between each finished product batch.

After the map flowchart elaboration, it has pointed some failures related to the disposition planning of the raw material, machinery, and the physical space organization.
It has been noticed that the raw material, people, and non-finished products stream is not linearized, and this cooperates to the appearance of intermediate batches and consequently, affects the priority of each request, by not following a continuous stream.

This cooperates for the generation of disorder and loss of movement. The solution would be to create a rearrangement of the equipment positioning aiming to decrease the distances between the sectors that need to be close to each other.

B. Proposal to a Rearrangement Enhancement of the Productive Sector

With the collection of the information and observations during the productive activity and giving emphasis to the people and materials' movement stream optimization, it has been an elaborated proposal of a new distribution of the posts in the productive process.

To the new map flowchart proposal, it has been considered that the order of the operations would be the same, once the more efficient change would generate high costs, and consequently, it would affect the productive process progress and would result in the decreasing of the productive capacity. With this, the map flowchart assists correctly to the process stream, as shown in the Fig. 5.

The rearrangement of the direct impact from the manual mounting process because it aims to assist the people and material enhancement stream. With this, the map flowchart has been elaborated in order that the final transport of all activities of the process would be reduced as much as necessary, decreasing the crossed streams over the paper bag fabrication. Therefore, we can list the following changes:

- Positioning change of the hot stamp machine: In the productive process, there is a cutting and creasing machine and another hot stamp, which the machine is badly positioned, obstructing half of the aisle what ends up creating a bottleneck in the finished product movement time. The change would be a distancing to keep aligned with the cutting and creasing machine, which is used in the SP005 bags' fabrication. An organization of the knife's shelves used in the cutting and creasing machine could already enable this change. Clearing the aisle, avoiding interruptions in the creasing bags' process.
- Mounting and collage: The mounting and collage table of bags has been found in front of the pressed material. Its side has put it, reasonably by the decreasing between collaborator and stock, as long as are two processes that need to be close. With this, it’s avoided that the collaborator leaves his workplace to replace material. It has been suggested that the stock printed material would be organized in wood pallets, reasonably because it’s a product that needs some care to avoid being damaged.
- Drilling and stitching machine: The drilling machine is positioned in a place that hampers the operator movement, besides being next to the stitching table. The organization of an area that nowadays serves to diverse materials accumulation enables to do the table and machinery movement to help the in the fabrication process stream of bags in only one way. Such change has also as the consequence the decreasing of the operator’s movement.
- Finished products stock: With the flowchart analysis, it can be realized that the packing table’s side has found the intermediate stock of finished products. In the current arrangement, the finished batches are put by the tableside, and this ends up obstructing the people's movement stream, besides the bad conditioning can damage the ready bags. In the proposed stream, it has been gained space to organize this product stock, allowing to conditioner them in wood pallets, enabling to organize these batches and ease the movement on the finished product stock.
V. CONCLUSIONS

Over the course of the study done it has been observed problems: unnecessary transport, high number of intermediate stocks, physical useless spaces and improper people positioning, finished products and machinery. It ends up generating a confusion by the lack of an ordained planning in the machines and equipment installation.

With this, the analysis done has searched for offering changes over the observed products aiming to reduce unnecessary movement during the paper bag fabrication process, taking into account the efforts for not impacting in high financial investments because of the context of this pandemic, where it has become essential to the contingency of expenses and better utilization of the resources. Only through the construction and analysis of the flowchart and map flowchart and enhancement of techniques for the physical arrangement it has been possible to offer to the company improvements with the main aim to the productivity increase and costs' reduction. So that the enhanced spots can be really achieved, it’s necessary that small changes in the physical arrangement and spaces organization, providing an expenditure reduction with shift and reduction of lead time production.

It is important to highlight those other spots could have been approached, for example: ergonomics evaluations in workplaces, worksheet elaboration, the proposal of a preventive machinery management plan and questions such as security and workplace hygiene. Although, the focus of this study was to improve productivity, having as a focus the minimization of movement loss, leaving the ideas below as a suggestion to other studies.

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Weverton Abreu Cascais is a student of Production Engineering at the Federal University of Amazonas, and researcher under SUPER project.

Marcelo Oliveira is an Adjunct Professor of Department of Production Engineering and member of Master Program in Production Engineering, Federal University of Amazonas. He has published several Research Papers related to Engineering area.

Gabriela Veroneze is an Adjunct Professor, Department of Production Engineering and member of Master Program in Production Engineering, Federal University of Amazonas. She has published several Research Papers related to Engineering area.

Joaquim Craveiro is an Adjunct Professor, Department of Production Engineering and member of Master Program in Production Engineering, Federal University of Amazonas. He has published several Research Papers related to Engineering area.