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ORIGINAL ARTICLE

Layout planning with the style changeovers in development centers: A case study in apparel industry

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Abstract

Purpose: We conducted this study in a selected garment manufacturing firm, where the sample room used a fixed layout system. As a result of this, inefficiencies can be noticed with the frequent style changeovers. Resultantly, the firm had to confront several non-value added activities, which in turn, incurred additional costs. We attempted to identify the importance of the sample room layout planning with style changeovers to improve this firm's operational efficiencies. **Methodology:** We collected data referred to one garment cluster representing both fixed and pre-planned layouts. We intended to provide a head start in finding out the factors that contribute to less productivity and less efficiency experienced by the apparel development centers due to poor layout methods. We used graphical representation to understand positives and negatives of layout methods and make conclusions. **Findings:** The results identified a positive impact of operator motion reduction, and improved the sample room efficiency. Further, we also noted that enhanced layout assists in reducing sample sewing delays, which in turn, facilitate fewer fit cancellations. Moreover, we facilitated the pre-planned layout in order to reduce sample completion time. **Implications:** Effectively, we identified the importance of layout planning according to the style changeovers, especially with regard to the study factors selected for the development centers in the apparel manufacturing sector. An effective layout management technique always enables to shorthand the production process, which ultimately reduces operational costs. **Originality:** Elimination of non-value adding activities when updating the layout is always profitable, and improves the overall performance of a firm's operations.

Key words: Employee engagement, fixed layout, garment industry, layout planning, sample room efficiency, style changeover
JEL Classifications: L67, M11, D24, L25

INTRODUCTION

Clothing, food, and shelter have been recognized as the most fundamental necessities of people worldwide. As individuals, we cannot live without putting on garments. Clothing thereby, is one of the essential needs of individuals (Hofmann et al., 2012). Clothes also need to fit well, and look attractive; hence, acquiring some understanding of the primary stages in clothing manufacturing is required. These stages include designing, pattern making, layout or layout planning, cutting, sorting, construction, finishing, and packaging. Among these, layout design is an influential

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factor for any firm's performance in order to support the streamlined production process (Anbumalar and Raja, 2016; Hossain et al., 2014; Battini et al., 2011). Today, firms are increasingly facing complex challenges in terms of increasing their efficiency to remain competitive (Suhardi et al., 2019; Anbumalar et al., 2014). Diponegoro and Sarker (2003) stated that in practice, 'assembly line layout' is usually arranged based on the subjective experience of technicians. However, fixed layout scheme has some disadvantages, such as poor adaptability and low fluency of semi-finished products. This may result in lower production efficiency, and higher costs in production and logistics. Many apparel firms have established sample rooms as development centers. However, most of those centers have not been involved with any layout designing concepts. Usually, many of these centers use a fixed layout method. With the use of fixed layout procedures, non-value added practices and low development efficiency can be observed.

Styles requested by customers vary according to main seasons and sub-seasons every year. As a result, machine consumption varies with styles. Having a fixed machine layout in the sample room causes excess motions of operators and waiting lines, ultimately affecting sample room effectiveness of operations. Furthermore, some quality issues, fit cancellations, and inability to meet on-time delivery can also be observed due to the aforementioned layout problems. Notably, most of these causes add up to the firm's costs. On the other hand, there are quality issues and long development lead time, which tend to lead to customer dissatisfaction. Additionally, these scenarios also lead to zero or lower utilization of some of the sewing machines in the sample room, due to which, these machines make the current layout inefficient. Resultantly, renewed interest in production efficiency in the apparel industry can be noted.

Thus, it may be affirmed that layout planning is one way to reduce manufacturing costs and increase productivity (Wiyaratn and Watanapa, 2010). Due to a rapid increase in production demands in the apparel industry, identifying potentials in production effectiveness has become a significant concern for the management of these firms. The absence of layout planning mechanisms in many development centers to meet the requirements of frequent style changeovers is a challenge noticed by many firms. To understand the operational efficiencies of layouts, simultaneous investigation is required, and it is always a worthwhile objective to achieve. As a result, we conducted this study to identify the importance of layout planning in order to increase sample room efficiency, and reduce non-value added activities, using a pre-planned layout system. We justify the significance of layout planning for each style changeover, while overcoming some of the adverse outcomes due to the specified fixed machine layout. Furthermore, considering significant implications of layout planning on operation, reduce operator motions, sample room efficiency, fit cancellations, and sample room completion time were considered for this study. On the other hand, implications of layout planning to increase the sample room efficiency, which denotes waste time on motion, are to be identified through this study.

LITERATURE REVIEW

By definition, arranging the factory floor machinery and equipment aiming fastest flow of materials at the lowest cost is identified as facility layout (Sutari and Rao, 2014). Similar to that definition, sewing layout in the apparel industry is a sequential arrangement of sewing machines as per processes involved in a particular style of garments. The apparel layout directs the flow of materials and work-in-process from the start until completion, and integrates material handling and equipment (Syduzzaman and Golder, 2015). Notably, the production floor in the apparel industry faces considerable challenges with frequent style changeovers, which in turn, require updates in layouts to get optimum usage. Thus, the capability to reconfigure an existing manufacturing system is crucial to maintaining competitiveness (Balakrishnan and Cheng, 2007). An ideal plant layout should provide the optimum relationship among output, floor area, and manufacturing process. It should facilitate the production process by minimizing material handling, time, and cost, and should allow flexibility in operations to facilitate easy production flow. Moreover, such an environment should make economical use of the building by giving maximum exposure to natural light and ventilation. Additionally, an ideal plant layout should promote effective utilization of the workforce by providing convenience, safety, and comfort at the workplace. Notably, these are important to the firm, since they affect the flow of material and processes, labor efficiency, supervision and control, use of space and expansion possibilities, etc. (Meller and Gau, 1996). According to Bhawsar and Yadav (2016), the improvement of facility layout can significantly reduce the distance and time of materials movement from one workstation to another.

Operator motions are recognized as user movements in the workplace. It is not necessary to be a part of walking. Although the movement is an essential part of the operation, it can be identified as one of the key waste generating activities in the workplace. This has been recognized even in lean manufacturing. The most obvious cause of unnecessary operator motion is lowering work efficiency.

As a result, all non-value adding movements of a worker can be identified as a waste for the firm, reducing thereby its productivity, while causing quality defects (Rahman and Amin, 2016). As a result, to maintain a productive work floor, an efficient production layout is required by limiting operators' excess motion. Most of the time, such excess motion at workstations is found due to poor layout planning and the workers' habit of carrying out their job in traditional ways. As per Huang et al. (2015), waiting time and bottlenecks were most common in the sewing section due to lack of engineering and wrong manufacturing layout. As a result, eliminating wasted or redundant movements have been identified as one of the key objectives of layout planning (Sharma et al., 2017).

On the other hand, sample room efficiency minimizes the waste of resources, such as physical materials, energy, and time, while successfully achieving the desired outcome. Sample room efficiency is a measurable concept that can be defined by determining the ratio of useful output to total input. According to Sudarshan and Rao (2014), the output can be taken as the number of products manufactured in the garments industry, while input is the people, machinery, and factory resources that are required to create those products within a given time frame. In fact, in an ideal situation, the input should be controlled and minimized, and the output must be maximized. Thus, manufacturing industries need to focus on improving efficiency through systematic and effective layout designing in order to remain competitive in the marketplace (Anyanwu, 2000). Effective layout may be represented through the physical arrangement of machines, processing equipment, and service departments, which could maximize a plant's productivity and efficiency (Syduzzaman and Golder, 2015).

Moreover, for the economic advancement of an organization, the product must be manufactured in the shortest possible time (Chisosa and Chipambwa, 2018). Abtew et al. (2020) have revealed that the per unit cost and task completion time would increase, when the operator takes more than identified single minute value (SMV) to complete the given task. To overcome this problem, and to enhance overall production, a major focus on sample completion time is required, specifically in this labor-intensive garment industry. In fact, using 'labor' efficiently by reducing manufacturing cycle time has also been identified as one of the main objectives of layout planning (Sharma et al., 2017).

Fit session is another important criterion in a consumer's evaluation of an apparel product. Apparel manufacturers develop sample size garments for a specific target market and range as part of the product development process. The fit session serves as the main point of evaluation of a sample garment during the product development process. A fit model tries on the garment, and provides insights into the fit and comfort of the same (Bye, 2006). The model fitting session takes high cost for the firm, and it delays the development process thereof. As a result, fit session cancellation becomes a huge cost burden to the firm. In fact, a fit model poses a challenge even for development centers with frequent style changeovers. Thus, having higher flexibility in layout planning is vital to minimize cancellation of the fit model session. Additionally, it may be noted that product development centers are always connected with their customers, and try to achieve the agreed development timelines to fulfill customer satisfaction (Ashdown and Dunne, 2006). On the other hand, customer service time can be reduced through layout planning. Moreover, enhancing interaction among both workers and customers is also one of the prime objectives of layout planning (Sharma et al., 2017).

METHODOLOGY

Under the study, we investigated the current layout and its non-value added points in a sample room of a selected factory. We identified the efficiency level of the existing fixed layout by analyzing operator motions, fit cancellation due to the sample not being ready, sample room efficiency, and sample completion time. Then, by analyzing all the upcoming styles, we created effective layout plans by considering the most effective layout, according to constructions and considering construction breakdowns. After that, we collected related information on the above studying variables. Then, we compared the data and justified the importance of layout planning according to seasons and style changes in a development center. Notably, this is a qualitative study, and the data collection process was mainly realized through sample room observation. Further, available sample room records of January–June 2021 were used as secondary data. The data collected refer to two layout methods: the existing fixed layout method and the proposed pre-planned layout method. The same style was considered for the data collection and maintained all the other factors as constant in the sample room.

DATA ANALYSIS

Comparison of Operator Motions

Operator motion is the total distance, which is 'operator-passed' when moving from machine to machine for different

operations to complete the sample. As a variable, the whole distance that the operator moved to complete the sewing operations in the sample room was observed. Comparison of operator motions in selected two different layouts is important to identify the unnecessary motions of operators due to poor layout systems. Figure 1 shows the graphical comparison of the operator motions to complete the selected sample with a fixed layout (before) and planned layout (after).

According to the above figure, the planned layout method could reduce operator motion during the sample completion time. Operator motion shows 203.97 m of mean value with the fixed layout method. It was reduced to 175.67 m with a planned layout. 11.27 of low standard deviation shown by planned layout method. It means that method has less deviation of operator motion valued with respect to the mean value. Less range is also shown with the planned layout method. For the above-selected styles, 24.57 is the mean SMV. Using the improved method, the sample room can reduce the waste time nearly by 0.47 min. With respect to the SMV, it indicates 1.93% of savings.

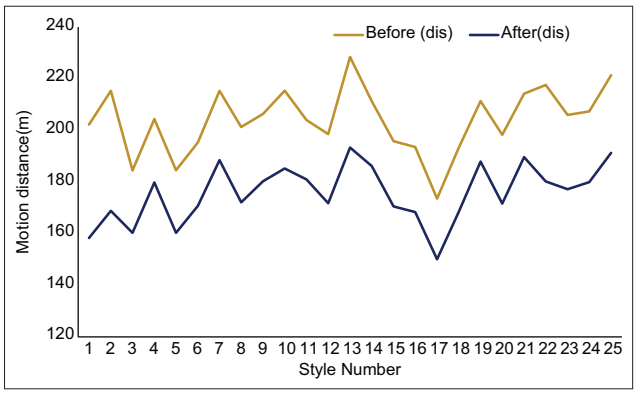

Figure 1: Comparison of operator motions

Comparison of Sample Room Efficiency

Sample room efficiency is the ratio between numbers of input cut kits into the sample room and output samples from the sample room per day. Efficiency is one of the performance indicators in the sample room to identify smooth running of its operations. Figure 2 describes how the sample room efficiency deviates from the selected layout methods.

Furthermore, Figure 2 illustrates the sample room efficiencies, when it uses two layout methods separately. The figure clearly shows that the pre-planned layout method can increase the sample room efficiency. According to the analysis, the sample room has 34.87% of mean efficiency with a fixed layout for a day. Using a pre-planned layout in the sample room, the efficiency rate can be increased up to 39.4% per day. At the same time, the above analysis of the newly introduced layout method implies a lower dispersion of data relative to its mean since the standard deviation of the new layout efficiency is lower than the original method.

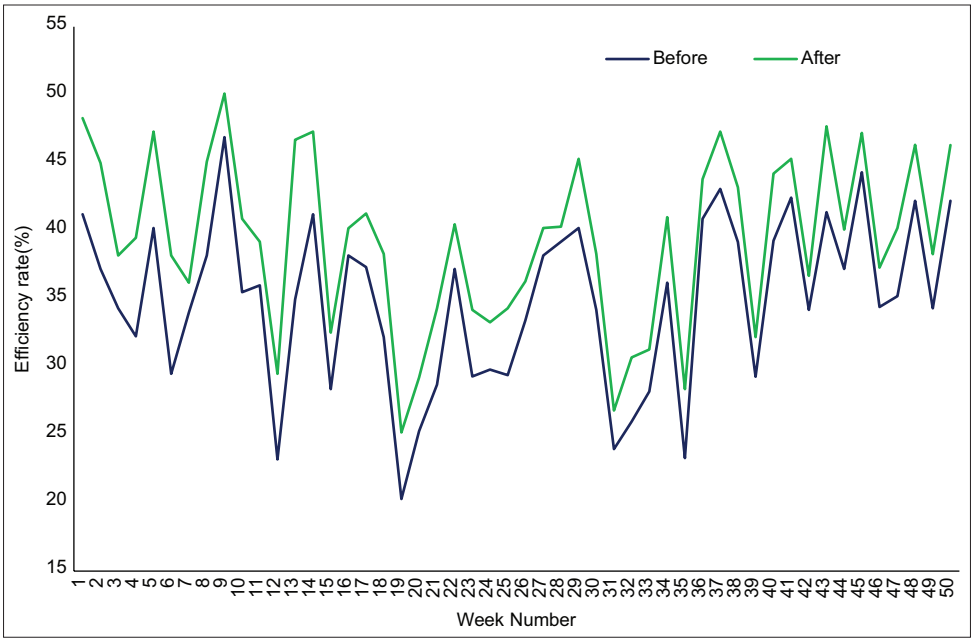

Figure 2: Comparison of sample room efficiency rate

Comparison of Fit Cancellation Due to the Sample Sewing Delays

In the development centers, the planning team usually plans sample fit sessions according to fashion calendar dates. Due to the sample sewing delays at development centers, some of the scheduled fit sessions have to be cancelled. The figure below describes how fit cancellation varies compared to used layout methods.

Figure 3 clearly illustrates a significant reduction of fit cancellations when sample room using planned layout method. Nearly fit cancellation due to sample sewing delays has dropped by 5 for a week. Fit cancellation amount relative to the mean value also dropped by 2 with the planned layout method. This result proves the advantages of the pre-planned layout method in the sample to complete the sample on time.

Comparison of Sample Completion Time

According to the construction breakdown, sample completion time is the total sewing time that the operator takes to complete all the operations to make a complete garment. In the production environment, it is near SMV.

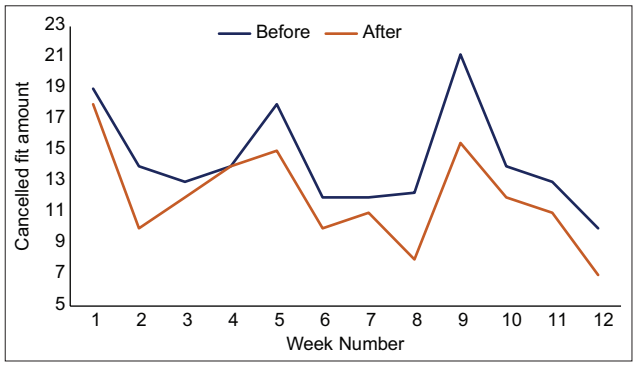

Figure 3: Comparison of fit cancellation

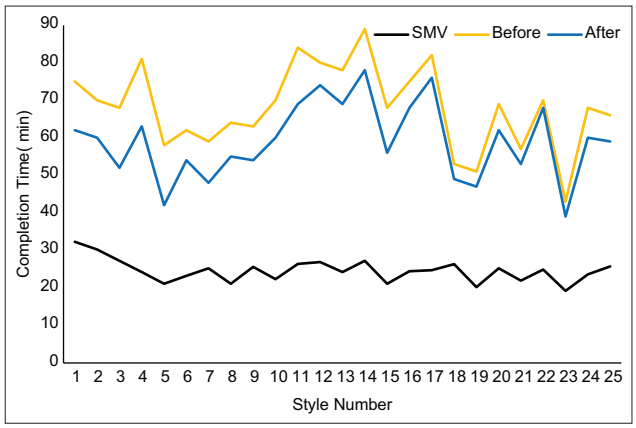

Figure 4: Comparison of sample completion time

Figure 4 shows that sample completion time for every style takes a longer time value than SMV. Even though, as per the analysis, sample completion time can be dropped by 36.78% with respect to the SMV using a pre-planned layout.

DISCUSSION AND CONCLUSION

Layout planning in advance involves planning decisions about the physical arrangement of Economic Activity Centers needed by various processes within a facility. However, good site layout is important to promote safe, effective and efficient operations, minimize travel time, decrease material handling, and avoid obstructing material and equipment movements (Tommelein, 1992). We conducted this study to identify the importance of layout planning according to the style changeovers in a selected development sample room in the apparel industry. Further, we tried to determine whether there is an impact on selected variables from the layout changes with style changeovers. For identifying variables, we reviewed extant literature related to the apparel industry. Thereafter, we compared the collected data on selected variables, and showed the impact of the layout system. We also understood and recognized the importance of layout planning, according to the style changeovers in the development sample room.

Workstation layout is the arrangement of the required items in a specified way at a designated area where specific job or jobs are performed. Ultimately, this study identified the reduction of operator motion through the layout updates. It implies that the proper analysis of facility layout design considering operator motions could improve the performance of the development layout. To do the operations within the least possible time, operators' movements are needed to be minimized. The components need to place within the nearest distance to the operators. Sample room layout should update according to the current developing garments and remove the unnecessary machines which were used in previous styles. As a result, the sewing tasks can be completed with fewer operator's unnecessary motions. These findings are similar to the identifications previously noted by Ahmed and Chowdhury (2018).

Further, the study identified the reduction of sample completion time and fit cancellations due to sampling sewing delays with the adoption of a pre-planned layout. It implies firm's ability to enhance productivity with the layout updates. This may have resulted in eliminating non-value adding activities when updating the layout. Similar

findings have been identified by the study conducted by Jalil et al. (2015), and they have revealed the reduction of the garment completion time by removing non-value added activities by adopting an effective layout model.

Moreover, sample room efficiency was enhanced using a pre-planned layout method. In other words, through the implementation of effective layout planning, firms can significantly reduce the operational costs of a sample room. As Chisosa and Chipambwa (2018) emphasized, effective layout designing practices bring new dimensions of techniques that help to complete a product at a faster and more reasonable cost. Therefore, it is recommended to implement a pre-planned layout system to increase the overall performance of the firm's operations.

This research will help contribute to Sri Lankan literature on factors affecting productivity improvements in development centers in the apparel sector. At the same time, this study is regarding a topic on which researchers have not yet been conducted much in the Sri Lanka context. The study will intend to provide a head start in finding out the factors that contribute to less productivity and less efficiency experienced by the apparel development centers due to the poor layout methods. Studies can be carried out in other operational industries as a future study by including further variables to bring more effective flexibility to the operations.

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DISCLOSURE STATEMENT

The authors do not have any competing financial, professional, or personal interests from other parties.

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