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Tesis

Application of method engineering tools to improve the productivity of the production system in the Textil Andes company

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Application of Method Engineering Tools to Improve the Productivity of the Production System in the Textil Andes Company

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Abstract. This paper on pre-experimental design proposes the application of methods engineering tools, focused on improving the productivity of the Textil Andes company dedicated to the manufacture of ethnic ribbons. By identifying deficiencies and bottlenecks, through the use of the operation process chart and routing diagram, the aim was to reduce the distances and times used, in fact, the processes are unique in the region, therefore it was decided to calculate their standard time which was 250.25 min, and that by implementing a new distribution and working methods it managed to reduce the standard time by 11.65% and the distances used by the product process flow by 49.51%; consequently, a less production time per batch added to the management of a periodic preventive maintenance format, generated a significant decrease in defective units; in other words, the number of good units produced, measured by efficacy, increased by 11.59%. Likewise, the reduction in idle time caused an increase from 89.07 to 94.28% in efficiency, thus achieving an improvement in productivity of 14.77% that directly influences attention and production capacity.

Keywords: Bottleneck, Efficacy, Efficiency, Methods Engineering, Productivity.

1 Introduction

The global shock of SARS-CoV-2 caused great repercussions in the economic sector, especially in the textile industry [1], in which 10% of the Gross Domestic Product (GDP) of the manufacturing sector in the country is included in the industry of textiles and clothing [2], where Peruvian companies strive to survive a critical recession in exports that indicates the 25 million dollars that took place in 2020, compared to 120 million dollars in 2019 [3]. In addition, the SMEs are the most affected due to the situation they face as they continue to survive in a market that forces them to make significant cuts in personnel and productive capacity, consequently, their productivity, which led to the failure of many of them [4]. On the other hand, the government poses the challenge of reactivating the textile sector by calling for the purchase of Peruvian products internationally; however, it is pointed out that we are perfectly supplied for local demand but not for global [5]; for that reason, companies and micro-enterprises, even with the situation against them, must begin to propose strategies to improve their productive level even with fewer resources [6], so that the reactivation plan is beneficial in economic terms. Therefore, the method engineering application model performs a corrective analysis, through a data record, indicators and operational diagrams [7], which greatly favors these small manufacturing companies in a shorter time, focusing directly on all the factors that negatively influence production and implementing immediate changes in the processes in order to optimize them and adapt them to continuous improvement [8,9].

2 Methodology

The objective of methods engineering is to reduce unproductive times and movements, in order to increase productivity in any manufacturing plant [10]. To identify the deficiencies in the process, which significantly affected the productivity of the company [11], the causes can be observed using the Ishikawa diagram (see Fig. 1).

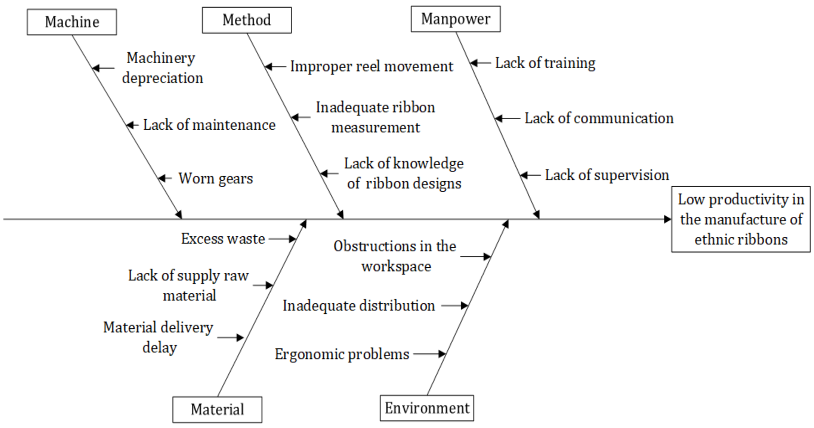

Fig. 1. Ishikawa diagram

2.1 Select the Product Process to Be Studied

The population was taken as all the processes for the manufacture of ethnic ribbons and as a sample the processes involved in the product with the highest demand [12], which was identified with the help of the bar chart, based on historical data from the first trimester of 2020.

2.2 Collect Information

Data collection was by direct observation and the use of method engineering tools: (a) Operation process chart shows the chronological sequence of all operations and component input, from raw material to final product packaging. (b) Routing diagram provides a graphical and sequential view of the flow of all operations and distances on a metric scale. (c) Standard time format, where the times observed in a given period were recorded, then the average time was obtained, which is multiplied by the valuation factor (performance rating) and supplements (time to carry out normal and physiological needs) to determine the standard time of the production process [13].

$$Standard\ time = Observed\ time \times Valuation\ factor \times (1 + supplements) \quad (1)$$

2.3 Critically Examination

Verification of the information obtained in relation to the problem presented, through an objective analysis that recognizes the productive capacity of the company [14]. The following formats are used.

Efficiency format. Idle times are identified for the calculation of the useful time, which is divided by the programmed time to obtain the efficiency rate [13].

$$Efficiency = \frac{Useful\ Time}{Programmed\ Time} \quad (2)$$

Efficacy format. The units produced minus the defective units in a period are recorded, then divided by the programmed units to find the efficacy rate. [13].

$$Efficacy = \frac{Units\ produced - Defective\ units}{Programmed\ units} \quad (3)$$

Productivity format. The indicators of distance traveled, standard time, units produced, efficiency and efficacy were considered. Therefore, the determination of productivity is reflected in a more specific and clearer way [13].

$$Productivity = Efficacy \times Efficiency \quad (4)$$

2.4 Devise and Define Methods

It consists of determining the new working methods in each cycle, looking for ways to include innovative elements, improved aspects and other perspectives that eliminate bottlenecks [15,16].

2.5 Implementation of the Methods

It is ensured that the new methods can be implemented, in other words, the organization and execution of all the activities involved in the proposal is carried out by using of the schedule of activities according to the availability of the company for the development of the methods [17]. To avoid interruptions and inconveniences in the development of their usual tasks.

2.6 Evaluation of the New Methods

The results and effects of the new methods are monitored, through the comparison of pre-test and post-test results of the established indicators [18].

3 Results

3.1 Selection of the Most Demanded Product

A study was done on the demand for all the products offered by the company, which are grouped according to their dimension: 1.10, 1.50, 2.50, 3.50 and 8 cm. After data collection, Fig. 2 shows that the 1.5 cm product is the one with the highest demand.

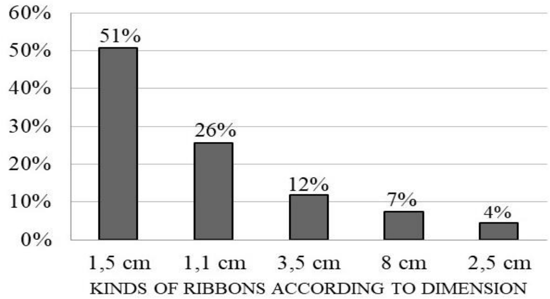

Fig. 2. Demand of the products of the Textil Andes company.

3.2 Compilation of Times and Movements

Manufacturing process cycles. The manufacturing process of ethnic ribbons begins in the preparation cycle where the thread cones are selected and put according to the ribbon design; they pass through a series of holes until they reach the empty reel, which is placed on the press of the winding machine. Subsequently, the winding cycle is performed when the threads are distributed on a reel and programmed according to the number of meters requested to be winded, where the operator manages the speed and monitors if any thread is finished or the breakage of this, once the reel is filled, the threads must be adjusted and carried to weaving area, for which the full reel is placed into the weaving machine and the threads are put in the appropriate holes. Finally, the measurement cycle, used the meters of ribbons are manually measured in 11 meters, which will be joined in groups of 10 to be packed in bags. The following is the operation process chart (see Fig. 3), which shows the sequence of activities in the 1.5 cm ribbon manufacturing system.

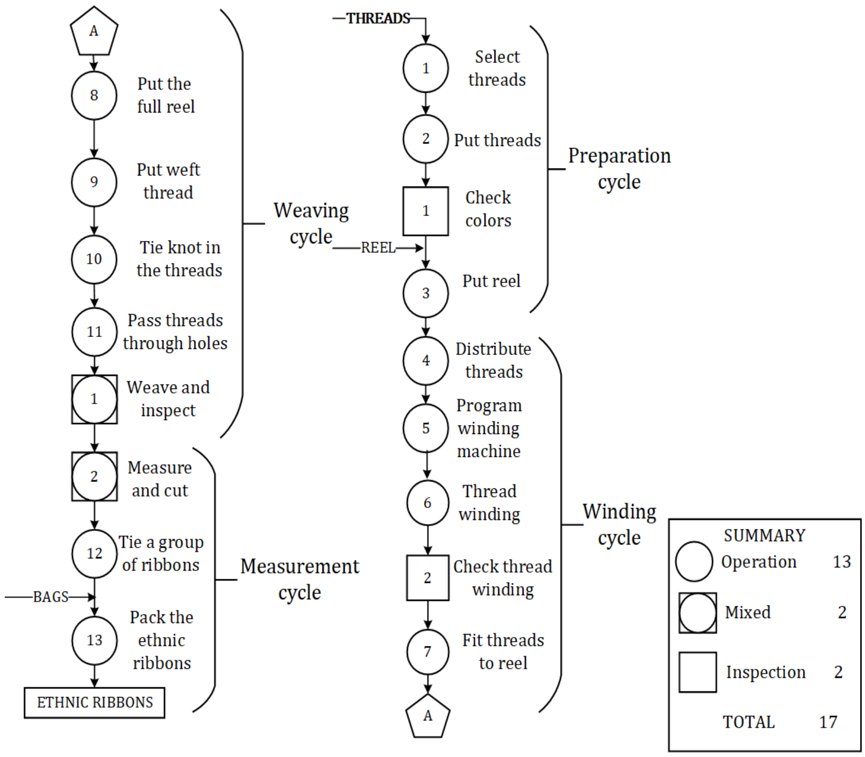

Fig. 3. Operation process chart of the ethnic ribbon manufacturing.

Register standard time. Data were taken from the execution times for each cycle, with a valuation of 95% and supplements of 14%, applying Eq. (1), 250.25 min was obtained as the standard time.

Table 1. Standard production process time.

Times	Production Cycles				Total (min)
	Preparation cycle	Winding cycle	Weaving cycle	Measurement cycle	
Average Time	33.895	86.712	81.382	29.081	231.07
Assessment	0.950	0.950	0.950	0.950	
Normal Time	32.200	82.376	77.313	27.627	219.52
Supplement	0.14	0.14	0.14	0.14	
Standard Time	36.708	93.909	88.137	31.494	250.25

Layout plant. By showing the layout of the production plant (see Fig. 4), it is possible to visualize the route required for the flow of each ribbon production cycle.

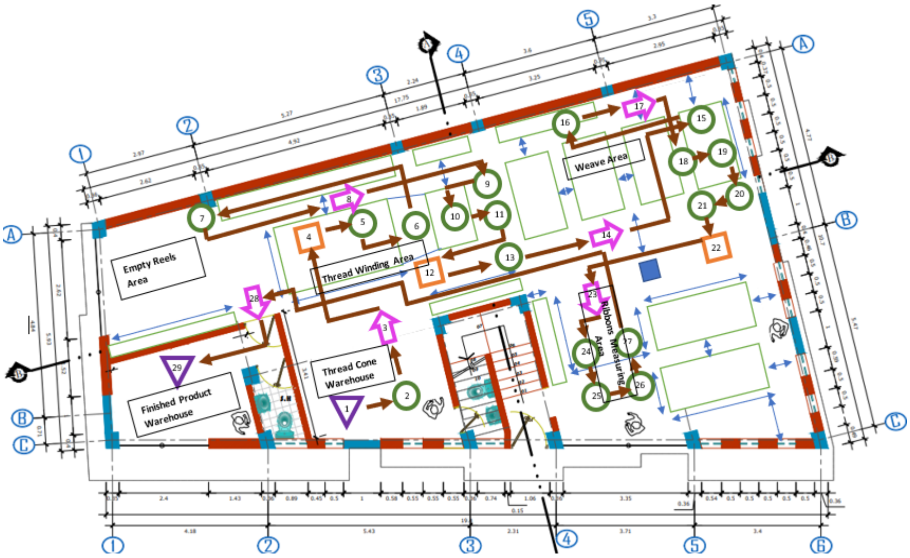

Fig. 4. Routing diagram of the ribbon production system.

3.3 Critical Analysis of Production Indicators

Efficacy. It is programmed to produce 6000 m of ribbons per day, however, on average 4579.45 m were produced, of which 161.90 were defective, applying Eq. (2) we obtain an efficacy rate of 73.63%.

Efficiency. There are 480 min available per day, but in the 15 days of the study, 52.48 min of idle time were obtained, so the useful time was 427.52 min. Applying Eq. (3), 89.07% efficiency was obtained.

Productivity. The productivity indicator involves efficiency and efficacy. With the above data and the application of Eq. (4), 65.58% productivity was obtained.

3.4 Approach to the New Methods and Distribution

Application of the new methods. The following methods were applied for each cycle: (a) Preparation cycle, the cones of threads are placed on the pendants according to the ribbon design; the color palette was implemented with the necessary information to speed up the process and avoid confusion. (b) Winding cycle, at the moment of winding the threads, they break or end, so a signaling of the route was made for a quick attention of any error. At the end of the winding process, a conveyor cart was implemented to take the full reel of 20 kg to the weaving area, to avoid possible injuries. (c) Weaving cycle, it should be noted that the machines need attention to avoid idle time, so a preventive maintenance format was implemented to control the functions of the weaving and winding machine, since stops production contribute to idle time, which we propose to mitigate. (d) Measurement cycle, there is no specific space for measuring ribbons; therefore, a suitable space was located and equipped with the necessary materials for its execution.

New distribution. For the new distribution, as is a small company, a criterion based on product flow and factors that influence the route for its production was used, maintaining the sequentially of the processes and oriented in a single direction, which obtains clearer areas of displacement and shorter route distances, as can be seen in Fig 5.

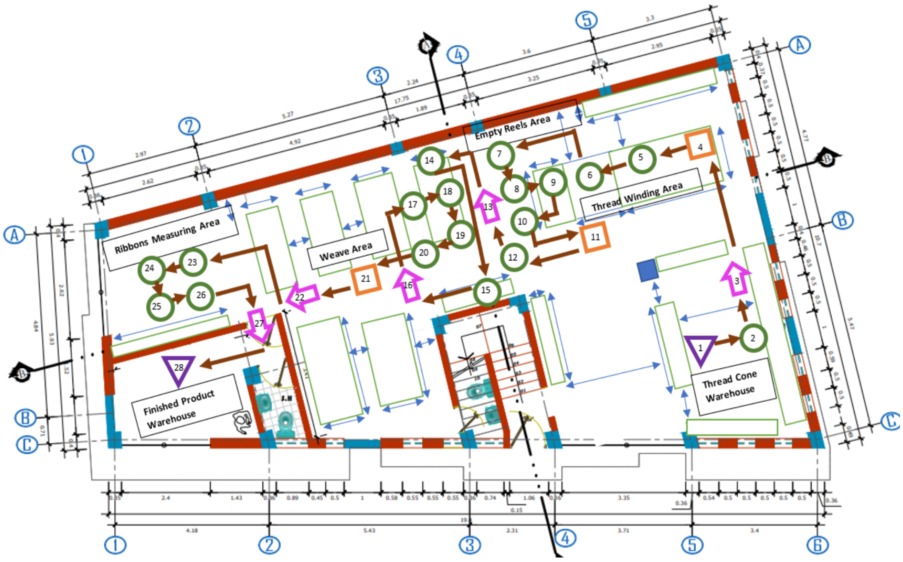

Fig. 5. Routing diagram with the new distribution.

3.5 Implementation of the New Distribution and Methods

For the implementation, the activities were scheduled according to the availability of the company, from July 15, 2020, to January 26, 2021.

Table 2. Implementation schedule.

ACTIVITIES	Jul	Aug	Sept	Oct	Nov	Dec	Jan
1.Distribution approach.	X						
2.Planning of new methods.	X						
3.Communication of the implementation to personnel.		X					
4.Resource preparation and conditioning.			X	X			
5.Implementation of the new distribution.				X			
6.Staff training.					X		
7.Implementation of new methods.						X	
8.Improvement review.					X	X	X

3.6 Implementation Evaluation

By applying the new methods, the standard time was reduced from 250.25 to 221.10 min. In addition, implementing the new distribution, a better route flow was obtained, the distance traveled by the product decreased from 192.60 m to 97.24 m. Table 3 shows that the production indicators improved, efficiency increased from 89.07 to 94.28% and efficacy from 73.63 to 85.22%, which gives an increase in productivity from 65.58 to 80.35% and shows an improvement after the application of the new layout.

Table 3. Production indicators.

Production Indicators	Results before	Results after
Useful Time	427.52	452.52
Total time	480	480
Quantity produced	4579.45	5168.34
Quantity programmed	6000	6000
Efficiency	0.8907	0.9428
Efficacy	0.7363	0.8522
Productivity	0.6558	0.8035

4 Conclusions and Recommendations

According to the study applied to the company, it was concluded, through the historical data of the first trimester of 2020, that the most demanded product is the 1.5 cm ribbon, whose production system had a standard time of 250.25 min and a distance traveled in the production process of 192.60 m, which were recorded by means of the operations process chart and the route diagram focused on the bottlenecks in each production cycle giving a faster and more complete result of the deficiencies of the company. Subsequently, with the implementation of the new distribution and work methods, larger workspaces were obtained for each cycle, better flow of movement and optimization of time in the execution of tasks, thus reducing standard time by 11.65% and distances routed by 49.51%. On the other hand, the production indicators improved after the implementation, resulting in a reduction of idle times, which helped to increase efficiency from 89.07 to 94.28%, also the number of defective units decreased, which contributed to increase efficacy from 73.63 to 85.22%, as a result of which productivity increased by 14.77%. Therefore, it can be concluded that the application of method engineering tools significantly improves the production system of ethnic ribbon of the Textil Andes company. Due to the relevance of the data collected, it gives rise to continue improving the research to involve other factors such as indicators of machine availability and performance, which provide a broader picture of the scope of the application of methods engineering and its integral use of the same, in addition, a study where the quality factor is complemented, due to the fact that when applying methods engineering it is required to improve times and speed up operations, so it is frequent that the quality of the products is affected.

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