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RESEARCH ARTICLE OPEN ACCESS

APPLICATION OF METHODS-TIME MEASUREMENT AS A TOOL TO IMPROVE PRODUCTIVITY IN A BEAUTY SALON

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ABSTRACT

The Methods-Time Measurement (MTM) tool has been gaining ground for offering cost-effective solutions for products/services, focusing on time reduction and wastage elimination. Aiming at the optimization of operations, this research aimed to evaluate the operational results from the MTM tool in a medium-sized beauty salon in the Tianguá-CE city. To carry out the study, the services provided by the salon were evaluated to verify the one that was most relevant, highlighting the services of manicure and pedicure. In these services, a diagnosis of the current scenario was carried out, and MTM were applied to identify opportunities for their optimization. After obtaining the results and analyzing them, it was possible to reduce unnecessary activities by 54.61% in the pedicure service and 62.57% in the manicure service, resulting in more agile, efficient, and low-cost services. In addition to reducing unnecessary activities, this improvement was possible through the standardization of the other activities that make up the service and the reorganization of the layout. Therefore, it is concluded that the application of the MTM provided gains in productivity and in the quality of the service provided, as there was a reduction in waste and greater agility in the service.

I. INTRODUCTION

The rapid technological evolution of the last decades has been one of the main driving factors for organizations to be able to constantly outline new strategies and thus remain competitive in the market [1]. These constant changes bring the need for adjustments in processes and operational procedures to seek increased productivity while maintaining the quality of products/services [2, 3].

In this context, the application of standardized operational methods, as well as the management of activities so that they could generate more value to production processes, have become indispensable for current organizations to remain competitive and one of the tools that allow identifying opportunities for this standardization is the Methods-Time Measurement (MTM) [4].

MTM increases the competitiveness of the business, making it possible to identify its productive capacity and correct its weaknesses in relation to competitors [5]. As we are experiencing a critical moment in the Brazilian economy, mainly because of the Covid-19 pandemic, it is necessary for organizations to be able to streamline their processes and this tool is a great opportunity for that.

Widely used in industry [4, 5, 6], however, there are already studies with its application in service providers, allowing an effective solution for product/service costs, with a focus on reducing time and eliminating waste [7].

The services segment has been greatly affected in recent years, mainly because of the current economic-sanitary crisis, with the stoppage of trade due to the expansion of the Covid-19 contagion. This situation has led companies to reinvent themselves

and seek alternatives to better manage their processes and thus increase their efficiency and competitiveness [8].

Another factor that can improve performance is the use of new technologies, which allows for greater flow of information and materials, providing a more solid and concise basis for decision-making [9]. Thus, organizations have been betting on new technologies for better process and product management, as well as identifying opportunities for continuous improvement.

In the quest to guarantee competitiveness, the application of the MTM allows maintaining the quality of services, reducing the idle time of some activities, and seeking continuous improvement of the processes [10, 11]. Banks are examples of service providers that, with the customer as the center of attention, their differential is in maintaining a service with quality, efficiency, and low operating cost [8]. In the same way, it is possible to perceive this situation in organizations that provide services of the most different segments, such as, for example, in a beauty salon.

In this context, according to the Brazilian Association of the Personal Hygiene and Cosmetic Industry [12], Brazil has been gaining ground in the beauty sector, being among the three countries that most invested and invests in this sector, behind only China and the United States, in relation to the global market.

In this type of enterprise, there is a high demand for services that has been growing every year, especially in Brazil, which, even in the face of an economic crisis due to the covid-19 pandemic, has been recording continuous increases according to the Brazilian Institute of Geography and Statistics, known by the acronym IBGE, and the Brazilian Association of the Personal Hygiene, Perfumery and Cosmetics Industry, known by the acronym ABIHPEC [12].

This high demand implies operational overloads that can result in customer dissatisfaction if the establishment does not plan and adapt its activities. Thus, operations management tools such as MTM emerge as an opportunity to optimize the processes and resources employed.

Faced with a scenario conducive to the growth of this type of enterprise and the opportunities for improvement through MTM, this study aims to evaluate the operational results obtained from the application of the MTM tool in a medium-sized beauty salon in the Brazilian Northeast, to improve the productivity of your operations.

II. THEORETICAL REFERENCE

II.1 METHOD ENGINEERING: FROM TIME AND MOTION STUDY TO CHRONOANALYSIS

One of the pioneering areas of production engineering is methods engineering, which studies and analyzes the work system with the purpose of developing the best methods and procedures for people or a group of people to perform tasks in the production system without difficulties [13, 14].

Method engineering has the purpose of developing the best methods and procedures for people or a group of people to perform tasks in the production system without difficulties [15], that is, this concept can be understood as the evolution of time, motion and chronoanalysis studies [16].

The study of time began in the first half of the 20th century through studies carried out by Frederick Winslow Taylor (1856-1915) whose purpose was to determine the standard times of processes, but it was applied only in industries [2, 17, 18].

However, it was with the studies of the Gilbreth couple that work encompassing various topics began to be developed, with emphasis on improvements achieved on fatigue and monotony. In addition to these, they also developed studies on micro motions, chronocyclographs and the process flow chart [19].

The objectives of the study of movements are to determine the appropriate methods for performing a task, through a detailed analysis of the movements performed during the execution of the task, seeking to eliminate unnecessary movements and actions that increase the time to perform the activity [17].

The study by the Gilbreth couple, due to the proven cost reduction, was disseminated in the routine of the industries since their studies of movements focused on three specific objectives: preventing unnecessary movements in a task, optimizing movements that do not add value, but that are necessary for the process and define the best sequence of movements [20, 18]. These studies presented a more scientific methodology than the one used by Taylor, with the use of filming equipment, photographs, among others, and thus, it was possible to determine the characteristics of the fundamental movements.

To design increasingly efficient work methods, planning and standardizing their procedures are essential for enterprises to increase their productivity [20]. Thus, the Gilbreth couple proposed the concept of "Therbligs", in which they classify into 18 elements and their respective symbologies, the elementary movements of human work, which are those precise movements that cannot be fragmented (Table 1).

Table 1: Elementary movements of human work.

Acronym	Movement	Acronym	Movement
SH	Search	**PE**	Position
F	Find	I	Inspect
ST	Select	A	Assemble
G	Grab	DA	Disassemble
ET	Empty Transport	U	Use
TL	Loaded Transport	UD	Unavoidable Delay
H	Hold	AD	Avoidable Delay
RL	Release Load	Pn	Plan
PP	Pre-Positioning	RL	Rest for Recovery

Source: Adapted by Yen [20].

This division of movements allows for a better detailing of operations, providing deeper analysis regarding unnecessary movements that do not add value to the product [21].

Chronoanalysis is one of the methods of time and motion evaluation, which is used to measure the time required for an operator to perform a task in production [22, 23]. Considering the physiological needs and fatigue of the operator, machines subject to breakage among other unforeseen events and, in view of the unforeseen events that may occur, a tolerance is considered over the proposed time [23].

With the updates carried out over time, the term study of movements and times started to have broader purposes, starting to emphasize the ideal method of process [2, 20]. So, the term methods engineering was suggested to be used in place of the term motion and time study [24].

Method engineering seeks to optimize workstations, establishing the handling and movement of materials, layout, tools to be used in the process and specific devices, through time measurements and rationalization of movements [25]. Complementing, [26], state that installing the best working method guarantees quality in the service, making the process more productive, agile, and more economical.

The increase in performance cannot be attributed to the physical effort of the operator, but to the increase in productivity resulting from the better use of movements. The improvement of methods can be divided into three stages, namely: planning, pre-

production, and production, where a new work situation is created [16].

The study of methods listed in the rationalization, idealizes efficient and productive methods maintaining the standardization of the processes, in which once implanted, and the performer properly trained allows the establishment of the method and the workplace [27, 28].

II.2 METHODS-TIME MEASUREMENT

Methods-Time Measurement (MTM) is considered a method that uses the evaluation of times and motions, initially implemented in the 1940s at the Westinghouse company, located in the city of Pittsburgh in the United States, by engineers Harold Bright Maynard, John Lenhard Schwab, and Gustave James Stegemerten [29, 30].

MTM consists of analyzing the basic movements of manual operations or existing methods, where a predetermined standard time is associated with each movement that is established according to the nature of the movements and the conditions imposed [31, 32].

For this, the main elements and their respective times are determined by filming the operations at a constant speed of 16 frames per second, facilitating the identification of the beginning and end. Operators must be properly trained to obtain better data, in addition to reducing operations times and improving existing methods [5, 31].

According to [30], it is not necessary to measure the time of the man as the operator, as there are corresponding times for each movement to be performed, that is, the chronometer becomes obsolete for the evaluation of time and movement. In parallel with the advance in the use of MTM in organizations, the MTM Association was created, developing some ramifications such as [30, 32]:

Table 2: Ramifications of MTM organizations.

MTM – GPD	American MTM Association
MTM – 2	Swedish MTM Association
MTM – SD	German MTM Association
MTM – UAS	Universal Analysis System
MTM – MEK	For production of individual parts and small series

Source: Adapted by Hengstebeck et al. [30] and Schröter et al. [32].

The basic movements considered by the MTM consist of five elements, reaching (R), grasping (G), moving (M), positioning (P) and releasing (RL), which constitute 80% to 85% of the human movements necessary for the performing a task or manual operation [30].

A standard time is assigned to each movement, represented by the Time Measurement Unit (TMU), where 1 TMU corresponds to 0.00001 hour and 1 second corresponds to 27.8 TMU's. [5, 32]. Thus, its implementation allows the uniformity of information, concept, applications and uses a single language that facilitates understanding and helps in the control of applications [29, 33].

III. MATERIALS AND METHODS

This research is characterized as a case study carried out in a beauty salon applying MTM in operational processes and procedures. For this, technical visits were carried out to observe the processes of the enterprise and seek to understand the services provided.

For data collection, a checklist was used that allowed the identification of services and their characteristics such as weekly demand, number of people involved in the process, the level of return to the salon by customers and the evaluation of the service (Figure 1).

Check List

Responsible for Checklist												Date	/ /		
Services	Service per week				Number of people involved in the service				Degree of return to the company			Customer evaluation			
	1	5	9	or +	1	2	3	4	or +	High	Medium	Low	Great	Good	Regular	Bad
1																
2																
3																
4																
5																
6																
7																
8																
9																
10																
11																
12																
13																
14																

Figure 1: Checklist of mapped activities.
Source: Authors, (2020).

After collecting these data over a period of one-week, electronic spreadsheets were used to analyze the information and identify the service that has the greatest demand. This service was monitored through video recordings and, to provide greater accuracy in the information, the same operator was recorded in each service he performed.

Then, the stratification and identification of the movements performed in the operation were carried out, through the Kinovea program (specific software for this type of study), which allows the capture of the exact moments of each movement and its timing in milliseconds.

The video was attached to the software, reducing the speed of the movements for layering and timing. To analyze the movements and standard times established by the MTM, Table 3 was used as a basis.

Table 3: Standard fills for MTM moves.

OPERATION DESCRIPTION						
Description	**Left hand**	**Frequency**	**TMU**	**Right hand**	**Frequency**	**TMU**
Total Time						
Description	**Left foot**	**Frequency**	**TMU**	**Right foot**	**Frequency**	**TMU**
Total time						

Source: Authors, (2022).

Each movement was treated in a table with its respective data, and, at the end, we sought to identify the standard times of each movement. These standard times were applied together with the others that were not transformed into MTM. Finally, the sequencing of the movements of the entire operation was standardized and the reduction of times was observed as a function of the standardization of the movements, analyzing the results obtained.

IV. RESULTS AND DISCUSSIONS

The company in the study operates in the segment of beauty services in a city in the Brazilian Northeast and has a team of employees composed of 13 people working in different activities such as: manicure, pedicure, hair hydration, hair bleaching, brushing, straightening, depilation, moon bath, among other services. It is considered as a medium-sized beauty salon, serving 78 customers weekly.

The physical structure includes a built area of approximately 91 m², however, because of the amount and arrangement of equipment, furniture, as well as the flow of people and materials, there are reports that some days productivity is impaired. The project's layout and activities are illustrated in Figure 2.

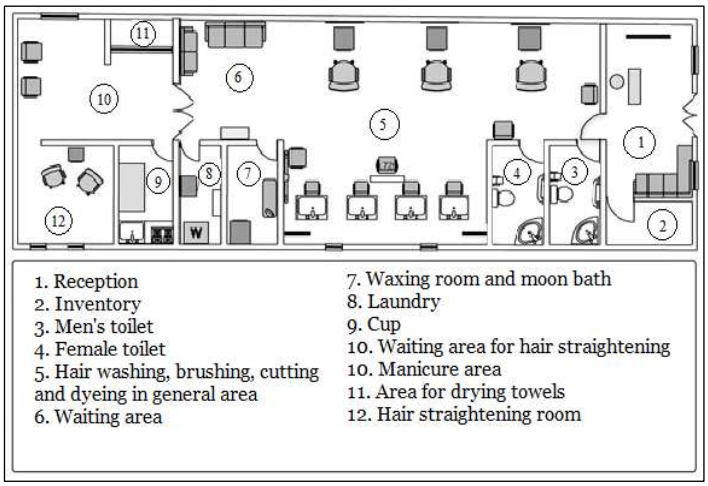

Figure 2: Beauty salon layout and its operations.
Source: Authors, (2021).

When analyzing the layout of the establishment (Figure 2), it was observed some points that hindered the fluidity of operations such as the bad dimensioning of the installed capacity, disorganization of equipment and tools, high level of movement and, in addition, the services of manicure and pedicures do not have a fixed location.

After collecting data through the checklist (Figure 1), the results presented in Figure 3 were obtained, where it was possible to verify 11 main services, the weekly demand of each one, as well as the evaluation of customers regarding the return of their return. to the place and its perception of quality, totaling 122 services performed that week.

This week, 78 customers were served, as mentioned above. Regarding the services provided at the enterprise during this period, 43.59% (34 customers) of the customers used manicure and pedicure services and 56.41% (44 customers) used the other services provided by the beauty salon. It is noticed that there are customers who consume several services in the same week.

Check List

Responsible for Checklist	Antonia Bruna Vieira de Souza											Date	08/08/2021		
Services	Service per week				Number of people involved in the service				Degree of return to the company			Customer evaluation			
	1	5	9	or +	1	2	3	4	or +	High	Medium	Low	Great	Good	Regular	Bad
1 Manicure and pedicure				34	x							x			x	
2 Hair highlights				20		x				x					x	
3 Blow-dry				15	x					x					x	
4 Discoloration Hair				12		x					x				x	
5 Eyebrow design				10	x					x					x	
6 Hair hydration				9	x						x				x	
7 Hair straightened (Intelligent)				6			x				x				x	
8 Progressive blow-dry				3			x				x				x	
9 Moon bath				3	x					x					x	

Figure 3: List of services, demand, and customer evaluation.
Source: Authors, (2021).

As the manicure and pedicure service presented greater demand, an in-depth evaluation was carried out, verifying the operator's movement, and recording of the 3 different services: only manicure; pedicure only; and manicure and pedicure.

The manicure service is one of the services of the establishment that most requires movement, where through the Flowchart map (Figure 4) it was possible to observe the number of movements performed by the employee in a service. The lines in blue show the amount of travel for the manicurist and the lines in red the amount of travel for the customer.

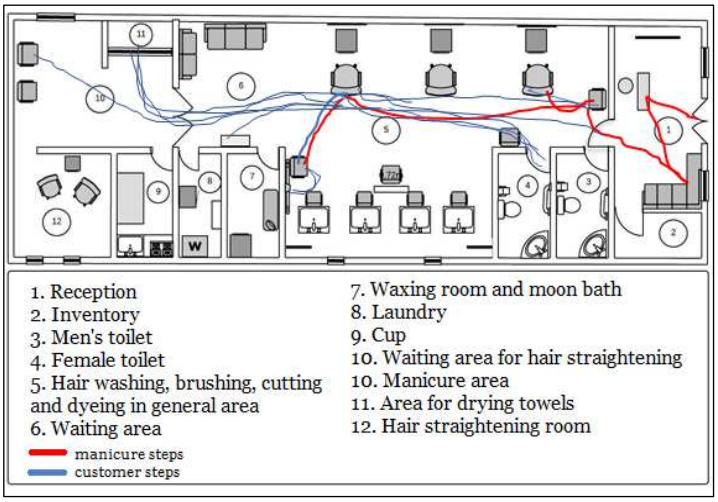

Figure 4: Flowchart map of the service provided.
Source: Authors, (2022).

The evaluated manicurist has no control over its operations and performs the activities according to the progress of the other services, not presenting a standardized service. Due to this, in a service she changes location more than once.

For daily care, the manicurist makes an average of 15 trips, with an average of 46 steps each, considering a standard of 0.5 meters per step. At the end of the service, she has performed 690 steps, which in meters she has walked 345 meters per day, the equivalent of 2070 meters per week of service (6 days worked each week). Table 4 presents these data in detail.

With the recording of this operator's process, her movements were stratified, making it possible to perceive that the clients who wanted to do the procedure only with the foot, it has an average duration of 44 and a half minutes, for the clients who want to do the service only with the hand, has an average duration of 50 minutes and those who requested both procedures, on the feet and hands, the average duration was 1 hour and 30 minutes.

Table 4: Service x Operator's Movement.

	weekly service	***monthly service***
number of trips	90	360
number of steps	4,140 steps	16,560 steps
Average distance walked (meter)	2,070 m	8,280 m
Total number of clients served by the service	34 customers	136 customers
% of customers served by the service	43,59%	

Source: Authors, (2022).

The first aggravating factor that enhances the long duration of the activity is linked to the attention that the manicurist needs to give to the client, because at times there are conversations that make it impossible to carry out the activity and handle the tools. The second aggravating factor is the management of your activity from one place to another, due to having another person also performing different procedures (which may be brushing, cutting, eyebrows, among other services).

With the stratification of the movements, it was observed that this service is divided into six movements, where they are subdivided into more movements between them. Among these movements, four of them tend to add value to the service and demand more from the manicure to perform, namely: sawing nails, enameling nails, removing cuticles, and exfoliating feet (Figure 5).

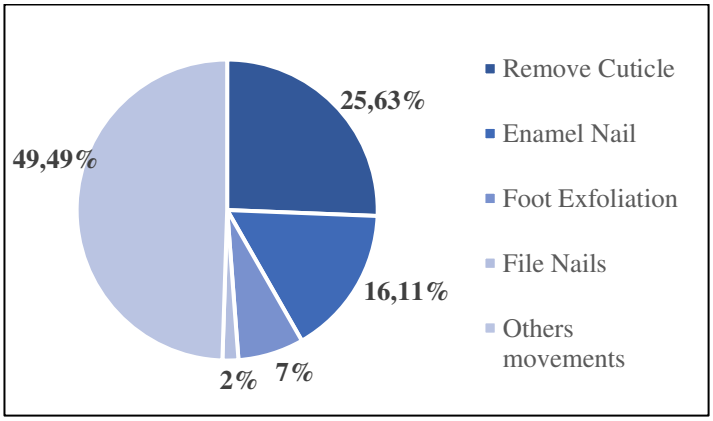

Figure 5: Graphic of the activities that add value to manicure and pedicure services.
Source: Authors, (2022).

It can be seen in Figure 5 that the movements that add the most value are the removal of cuticles and nail enameled, as customers see it as a product within the service provided.

Linked to the objectives of optimizing and standardizing the movements, it was decided to map and analyze these movements through the MTM tool, where it was possible to describe each operation through coding and a standard time established by the tool (Table 3).

Table 3: MTM analysis of pedicure and manicure services.

	Pedicure Service			***Manicure Service***		
movements	**Length of time**		**Reduction**	**Length of time**		**Reduction**
	Current (Second)	MTM (Second)	(%)	Current (Second)	MTM (Second)	(%)
File nails	48	11,05	77,00%	78	11,05	85,83%
Remove cuticle	188,48	49,11	74,00%	922,66	320,22	65,00%
Enamel Nails	606,51	320,22	47,00%	849,06	194,84	78,00%
Foot exfoliation	755,59	205,85	72,75%	-	-	-

Source: Authors, (2022).

All these analyzes resulted in the reduction of the total time of the manicure to perform its function, with a reduction of 54.61% in the total time to do the foot, passing to a duration of 20 minutes and 62.57% to do the hand, passing to have a duration of 20 and a half minutes.

V. CONCLUSIONS

During the pandemic period, the company suffered from the new health rules and had to adapt. This further required the organization to identify its weaknesses and eliminate waste to overcome these obstacles. Observing the results obtained, it was possible to perceive that the manicure and pedicure operation presents the greatest demand, and that the operator makes many movements that do not add value to the service and can be considered as a waste.

Applying Methods-Time Measurement (MTM) in the manicure and pedicure operation allowed us to better understand their activities and identify points for improvement. By optimizing this activity, we were able to achieve the objectives of this study, which was to evaluate the operational results obtained from the application of MTM in a medium-sized beauty salon in the Brazilian Northeast, to improve the productivity of its operations.

With the results obtained, it was possible to point out opportunities for improvement to the organization, with the perspective of making it more competitive in the market, better use of resources and with a focus on productivity, as it was possible to analyze its movements and reduce them, making it more agile. In addition, a reorganization of the company's layout was proposed, resulting in ergonomic improvements, reduced fatigue, and reduced physical effort by the operator.

In view of the above, it is concluded that this study can be extended to other operations of the establishment, as well as it can serve as a basis for other studies that use the MTM as a process evaluation tool aimed at optimizing operations.

VI. AUTHOR'S CONTRIBUTION

Conceptualization: A. B. V. de Souza, J. I. da S. Pierre and R. A. Rêgo Júnior.
Methodology: A. B. V. de Souza, R. A. Rêgo Júnior and E. de J. Lopes.
Investigation: A. B. V. de Souza, J. I. da S. Pierre and R. A. Rêgo Júnior.
Discussion of results: A. B. V. de Souza, J. I. da S. Pierre, R. A. Rêgo Júnior and E. de J. Lopes.
Writing – Original Draft: A. B. V. de Souza, J. I. da S. Pierre and R. A. Rêgo Júnior.
Writing – Review and Editing: R. A. Rêgo Júnior, E. de J. Lopes and F. A. F. da Ponte.
Resources: A. B. V. de Souza, J. I. da S. Pierre, R. A. Rêgo Júnior and E. de J. Lopes, F. A. F. da Ponte.
Supervision: R. A. Rêgo Júnior, E. de J. Lopes and F. A. F. da Ponte.
Approval of the final text: A. B. V. de Souza, J. I. da S. Pierre, R. A. Rêgo Júnior and E. de J. Lopes, F. A. F. da Ponte.

VII. DISCLOSURE STATEMENT AND ACKNOWLEDGMENTS

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