MWO Line Optimization Applying Lean Manufacturing Methodology: PIM Case Study

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Abstract

With the increasing competitiveness in the market and the constant development of technologies, today companies are constantly improving, the managers' concern is to achieve maximum process productivity with minimum losses and waste, thus reducing the value to the maximum. aggregate to the product and taking considerable profit margins from sales, so it is of paramount importance to have a lean production process, with well-balanced production times, a minimal amount of work in process and especially a minimal amount of labor , which has very high costs that generates added value directly in the product. In this study was applied the methodology, observation, quantitative and deductive based on theoretical references in order to maximize the efficiency of the production process, through the use of some Lean methods and quality tools as a way of discourse for process improvement also applying process balancing with the primary purpose of reducing the amount of direct labor. Thus the present study presented satisfactory results increasing the efficiency of the microwave oven production line, with the reduction of a direct operator, bringing a leaner and more efficient process.

Keywords: Lean Manufacturing; Process balancing; Efficiency.

1. Introduction

Faced with a highly globalized market, companies that seek to increase their competitive advantage through systems management, resort to Lean Manufacturing, whose goal is to eliminate losses in the production

process becomes a complete production system and is a reference in efficiency and effectiveness. , bringing cost reduction, higher productivity and quality in the production process, ensuring the survival of companies to respond quickly to customer demand. "How to increase process efficiency using Lean concept tools applied to a PIM Company MWO line?"

For Bhamu and Sangwan (2014) lean provides organizations with positive and competitive leadership by reducing waste and improving productivity, quality and controlling the efficiency and effectiveness of a given process.

The use of quality tools in corporations across a wide range of industries has evolved significantly and methods have improved, giving greater stability and reliability to product operations and service delivery. (BERGER et al., 2012).

The study will use the quality tool Brainstorming, as an aid to the brainstorming, because it is simple and easy to execute, it has become routine in the main companies in the world, this tool consists in generating ideas from a group of people. involved in a particular subject in a pleasant climate that is conducive to breaking taboos and without concern or criticism, this way I will apply it to the project team that involves the Quality, Engineering and Manufacturing areas, as it takes several process views to get the improvements.

This paper aims to apply the Lean Manufacturing philosophy to achieve resource balancing and optimization in a microwave oven production line.

With the implementation of the initiatives we will obtain very relevant results for the microwave oven line, where we will be able to maximize the process efficiency and to resize the activities of the workstations and to optimize some tests performed, and besides we can identify improvement points for future projects in the process.

2. Theoretical References

2.1 Lean Manufacturing

Lean Manufacturing also known as Toyota Production System was created in Japan after World War II where, in the 60's, the market demanded greater flexibility and together with the growth of competitors led to a new production system being developed. by engineer Taiichi Ohno and his team (OHNO, 1997).

According to (Carvalho 2014 apud, Henderson and Larco 2000), Lean Manufacturing is made up of various details in procedure format and methods, technique and processes that interconnect and act as a great gear for companies to pursue their continuous improvement. your processes and services.

2.2 Lean Tools

2.2.1 Just in Time

Just-in-Time is a means of manufacturing management created by the Japanese in the 1970s. According to Monden (1984) JIT's philosophy is: "Produce the necessary units in the required quantities at the required time." For Hamilton Pozo (2010) JIT is “a production philosophy aimed at eliminating waste in the total manufacturing process from distribution shopping”.

JIT is usually employed in recurring manufacturing when the same items are produced in sequence. This process shows that stocks hide problems. Therefore, in this practice all problems must arise.

2.2.2 Kaizen

Kaizen is a Japanese word, according to Siqueira (2005), in which Kai means change, and Zen means for the better. The Kaizen system is premised on continuous improvement and its philosophy is an important resource in the constant pursuit of improving productive and administrative processes, making them leaner and faster.

The kaizen cost method seeks to maintain current cost levels for manufactured vehicles and constantly work to reduce costs at all stages of manufacturing to achieve the company's desired values, helping to eliminate the difference between target profits and profits. estimated. (MONDEN, 1999).

2.3 Toyota Production System (STP)

According to Shingo (1996), the central idea of the Toyota Production System is to promote a harmonic flow of materials between workstations, producing components in the quantities and times they are needed. To this end, communication between jobs must be promoted efficiently. According to Ohno, the creator of the system, it can be summed up as “producing in the right quantities and when parts are needed” (OHNO, 1994).

During his visit to Ford companies, Taiichi Ohno formulated what he called "the 7 wastes" called "mounting" by the Japanese (WOMACK et al, 2004). That is: waiting, defect, shipping, handling, overstocking, overproduction, mishandling or over processing.

2.4 Mass Production

According to Johnson (1992) the concept of Mass Production was spread by Henry Ford and was also called Push Production, mass production began with the production of the Ford Model T, with 15 million units produced considering the years 1908. to 1927.

Mass Production is actually one of the possibilities of inline process production, which implies the existence of line flows in which both the products and the services offered follow a standardization.

2.5 Lean Production

It was conceptualized through the Toyoda System which represents a set of interconnected elements that make it possible to produce more with less and less resources, according to James P. Womak and Daniel J.Tones (1990), when he published the book “The Machine that Changed the World”.

According to Taiichi Ohno (1988) social values have changed. Now we can't sell our products unless we put ourselves into the hearts of our consumers, each of whom has different concepts and tastes. Today, the industrial world has been forced to truly dominate the multiple production system in small quantities.

2.6 Production Systems

According to Gerlah (2013) apud Moreira (2002), the production system is a set of activities and operations that are linked together, which together are involved in the production of goods and services. They can be classified into four types: continuous, mass repetitive, batch repetitive and design.

Combining production volume and degree of variety it is possible to assimilate the definition of the type

of layout to be chosen in the production system. Several times, based on the level of process complexity, there may be several types of production systems in a single layout.

2.7 Quality Tools

For an organization to meet a customer's needs, it is necessary to establish a system that integrates different processes within the organization, such as product manufacturing, development, sales, and marketing. This integration and the execution of processes must follow a methodology that reduces risks and increases the efficiency of the results applied (PALADINI, 2002).

2.7.1 Brainstorming

According to Miguel (2001), the Brainstorming tool means brainstorming, that is, thoughts and ideas that each team member can expose without worrying about the assertiveness or acceptance of their suggestion. It can consider, for example, the factor of influence of a specific problem (causes), later discussed by the group itself.

According to Fagundes and Almeida (2004) Brainstorming is a technique that allows group members to feel comfortable recording their ideas using creativity, which helps in the process of identifying solutions, which should follow some steps to formalize and sift the ideas in the discussion process seeks to define: The theme to be addressed; Definition of a leader representing the group; The group and the leader eliminate ideas in duplicate or in synonym; The group and the leader point out the causes related to the problems; Finally the leader prepares the final version of the analysis result.

2.8 Productive Management

2.8.1 Production Line Balancing

The quest to control waste reduction in the production process is the main scope of Lean Manufacturing and the continuous improvement process. Production Line balancing is one such tool that avoids waiting in the process allowing a continuous flow avoiding process stops (ABDULLAH, 2003).

Mapping the production line is the first step to balancing when using the lean philosophy, it is necessary to determine the cycle time, the downtime, calculate the inventory in process and the movement of products, all this survey. data helps to identify results in a future state (ABDULLAH, 2003).

2.8.2 Standardization of Methods

According to Ionak (2016) the standardization of the methods has a positive effect to reduce the losses generated in the production process increasing the quality in production. Implementing standardization for an organization or system is simple and inexpensive, and often only requires several process adjustments through analysis.

The standardization of the methods must be orderly so that the activity is performed as best as possible by any operator always seeking to eliminate non-value added activities. Flow balancing becomes increasingly effective with standardization of methods (Tapping et al, 2002).

2.8.3 Productive Capacity

According to Moreira (2011) is the maximum number of products or services that can be manufactured in a production system, over a certain period of time, this production system can be considered as a factory, a department or even a simple machine.

In order to calculate the production capacity of a given process it is necessary to have the value of the production rate multiplied by the available time of the operation over a given period of time. The result of this is the quantity of products that can be produced during the period considered. according to equation (1).

$$(1)\ Capacity\ =\ Production\ Rate\ x\ Available\ Time \quad \text{(Eq.1)}$$

2.8.4 Chronanalysis

Cronoanalysis is of great importance for the productive sector today, it is a tool that defines the standard time, helps in the organization of processes, being a mechanism that accompanies the continuous evolution of improvements. According to Novaski and Suagi (2002), it argues that Taylor performed a true rationalization of workers' work using the study of times and movements as an instrument.

Anis (2010) noted that companies and organizations are increasingly linked and focused on continuous improvement programs. The applied chronoanalysis results in real parameters by obtaining current and historical comparative data.

2.8.5 Operator Balance Chart (OBC)

The Operator Balancing Chart is used to define the activities that operators will perform on their jobs, also using takt time as the basis for distributing activities. Activities are defined as operations that add and do not add value to the product (GOMES et, al 2008). With the information, it is possible to distribute the activities and workload of each operator in a balanced way according to the time takt of the balancing graph. Once the graph is filled it allows to analyze possible bottlenecks in the production process of each workstation. job

2.8.6 Work Distribution

It is the definition of the number of operators. To perform line balancing, the number of operators required must be determined by dividing the total work content by the takt time as (EYNG et al, apud ROTHER & HARRIS, 2002).

The calculation of the number of operators must be done as shown in Equation (2).

(Eq. 2)

$$\text{Number of Operators}\ =\ \frac{\text{Work Content}}{Takt\ Time}$$

With the number of operators required to perform the activity, the jobs that will be occupied by the operators are defined (Tapping et al, 2002).

3. Methodology

The purpose of this study is to analyze the production process of a company through the use of continuous improvement tool and waste elimination in the production line. For this purpose, a field research was carried out with the objective of applying the Lean Manufacturing philosophy and executing it correctly to eliminate activities that do not add value to the final product.

3.1 Study Application

We applied the chronoanalysis and GBO tools of a production line in a particular company, it is located in Manaus Industrial Pole - PIM and works in the production of white goods, I chose to study the line that performs The assembly of the microwave oven, we have a line that operates in two shifts in seasonal periods that are from June to December.

The times of each post were obtained for balancing and identification of bottleneck posts for making improvements and suitability for the 14 second takt time.

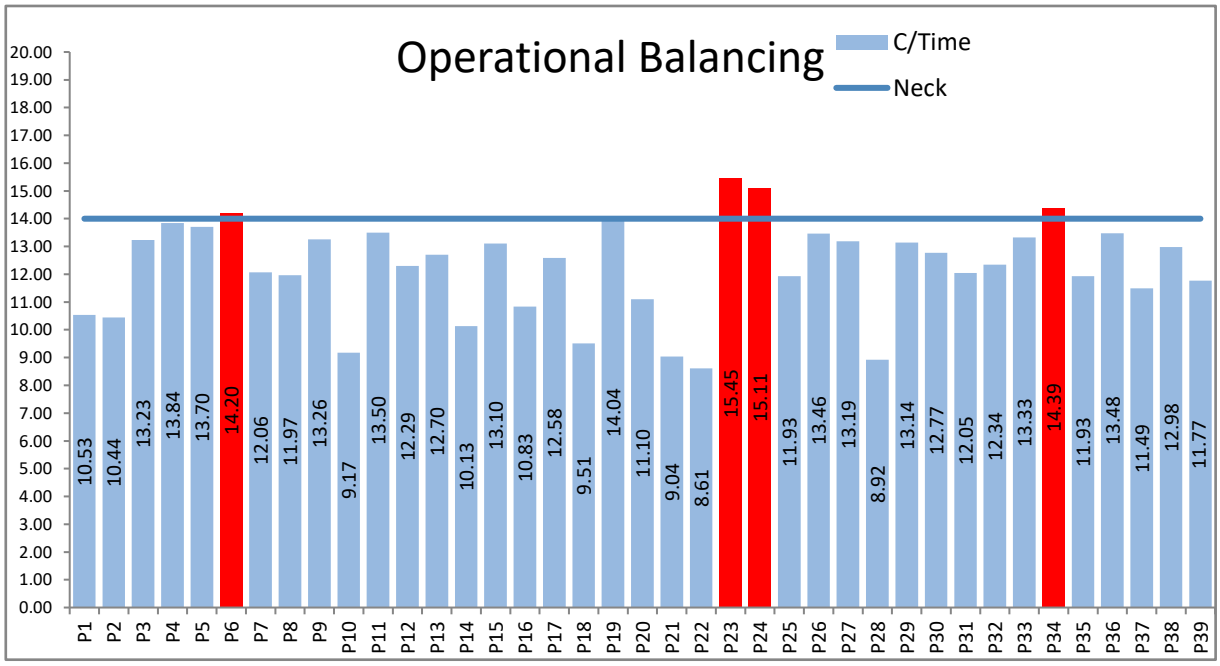

Figure 1 - Operational Balancing Chart (GBO) before improvement.

Source: Company

Below is the line layout, which will be modified if possible, according to the improvements applied.

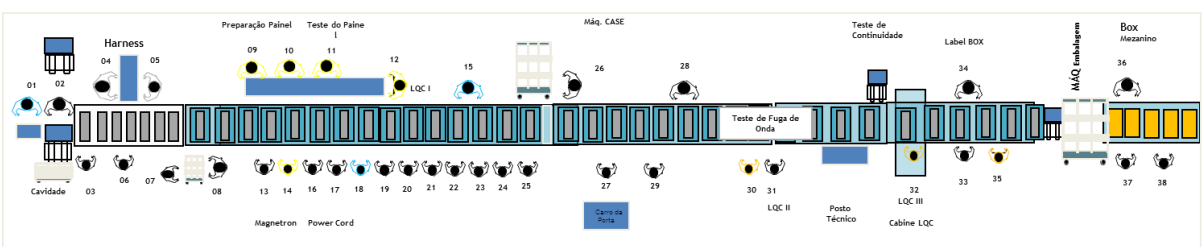

Figure 2 - Production Line Layout

Source: Company

3.2 Applied Improvements

3.2.1 Automatic Label Scanning

Manual scanning of the label for insertion of the monitoring and tracing system. In the improvement in question was installed a scanner to perform automatic reading.

Figure 3 - Process Improvement 1 before x after.

Source: Company.

3.2.2 Automation of the packaging process

In the line packing process, an operator was used to transport the box. A conveyor belt was installed from the box to the post that performs the final packaging process. Through this improvement it was possible to reduce one employee.

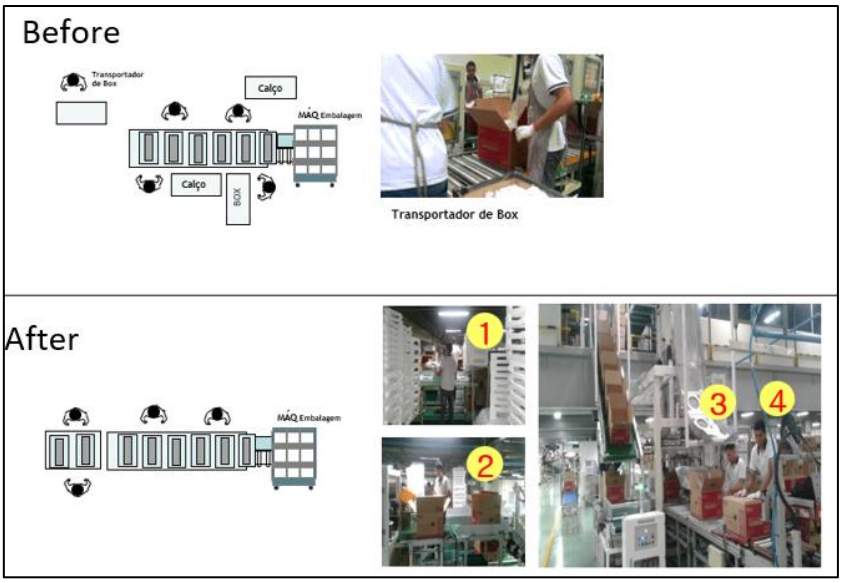

Figure 4 - Process Improvement 2 before x after.

Source: Company.

3.2.3 Changing the position of the cover package

The position of the cover package causes unnecessary operator movement. The position of the package in front of the operator has been modified, the new layout condition eliminated unnecessary movements and improved ergonomics.

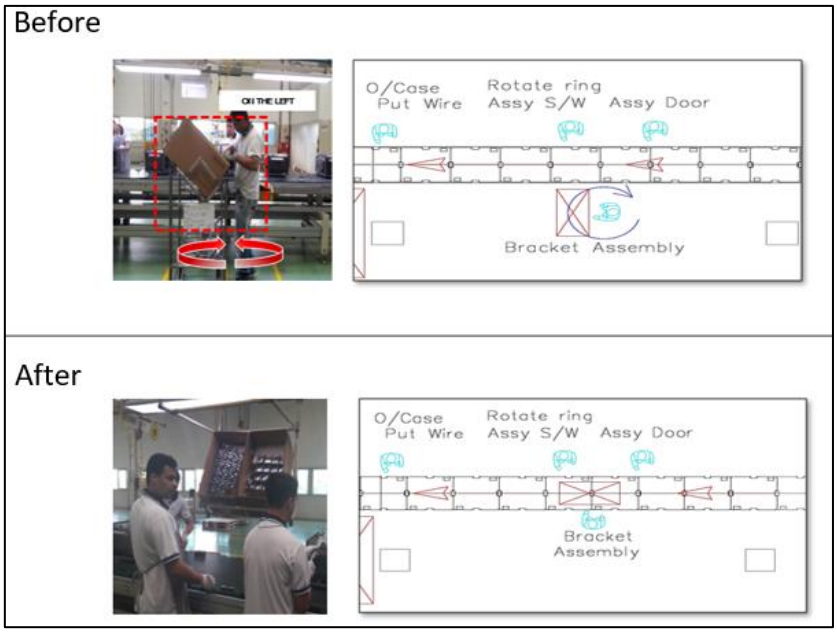

Figure 5 - Process Improvement 3 before x after.
Source: Company.

3.2.4 Guide to Product Positioning

In this operation it is necessary to position the product manually on the pallet, causing the plate to break and not triggering the sensor for automatic product packaging. A guide has been added to assist the operator in positioning the product in the correct location.

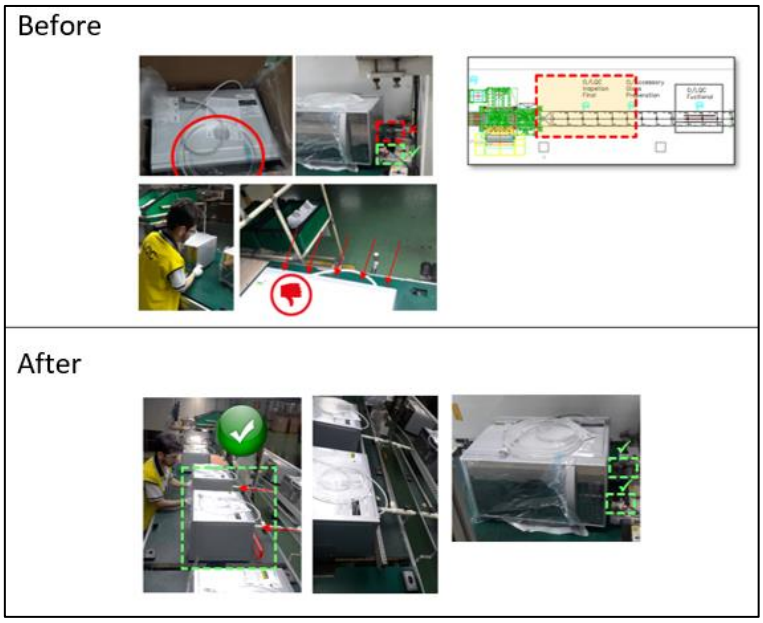

Figure 6 - Process Improvement 4 before x after.
Source: Company.

4. Results and Discussion

With the conclusion of data collection and the choice of demands to be defined, which are mostly balancing activities, we will now present in detail the processes performed to obtain the results proposed by the analyzes.

Using the Lean Manufacturing philosophy that also makes use of chronoanalysis to point out in the process where it is wasting time or how to reduce process time (cycle time). Thus, achieving the maximum yield in the industrial production sector, with the least possible investment (REZENDE, SILVA, MIRANDA and BARROS, 2015).

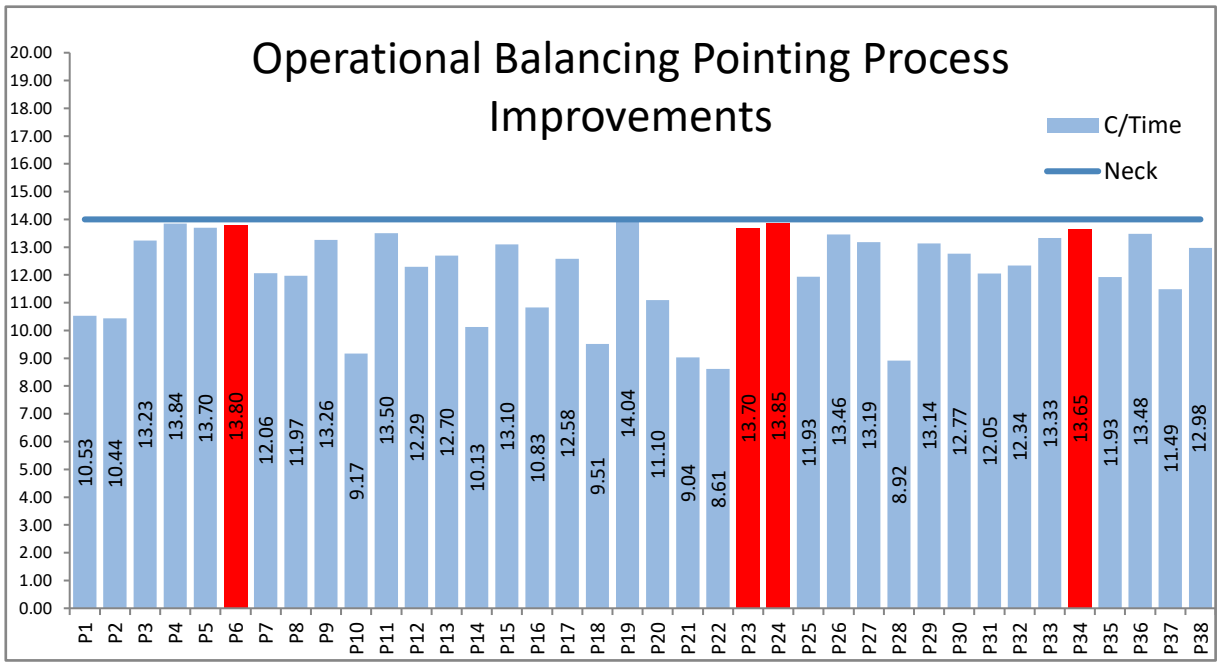

Figure 7 - Operational Balancing Chart showing process improvements

Source: Company

Thus, the initial objective of rebalancing the process by applying the time analysis and presenting in GBO graphs to increase the process efficiency was successfully achieved, since the delivery was performed within the estimated time of six months and not reducing the line hourly target. We already had high productivity and we gained efficiency in the assembly process by reducing the amount of manpower due to the automation of the packaging process.

Junior apud Rocha (2012), explains that the production engineers use calculations to elaborate the best flow of a process, number of stations and reducing line idleness. As well as simplifying losses by avoiding as much as possible, companies become more competitive in the market because they can achieve good productivity and with the lowest costs added to the product.

5. Conclusion

The present study aimed to optimize resources in a production line by applying line rebalancing, chronanalysis and GBO for time wastage analysis and thus improving process efficiency. With this was proposed a study in the process to identify the main bottleneck jobs, which we can consider were the cycle

time and the standardization of the production process, leading to the inefficiency of the line.

Therefore, after identifying the improvements, the process balance analysis was started, applying the GBO, for a better view of the whole, where we had 79.3% process efficiency results, with 39 operators, all due to the implementation of a process without visualization of lean methodology.

It was evident that it was possible to reach an acceptable denominator, keeping the takt of the process that was initially very relevant. With this, it was possible to obtain the expected results through the automation of activities, reducing the takt time of the bottleneck, eliminating such activities that were added to the operator, changing the layout of the station to reduce unnecessary movement and improve ergonomics, reducing fatigue and installation. structures that help the activities. Thus, it was possible to reduce the takt time of posts that were above the maximum allowed point of 14 seconds.

Thus, I was able to achieve results in reducing labor resources from 39 to 38 operators, increasing the efficiency of the manufacturing process from 79.3% to 84.2%, meeting the main objective of the study.

For future studies, I suggest the automation of some process posts. Thus, we can demonstrate that tools such as the seven wastes, line balancing concept and simple actions of how to identify the “bottleneck” post can contribute to the application of low cost improvements and thus result in larger unit of product per hour. producing on a production line optimizing these results.

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