Scrap Cost Reduction Process Improvement Actions in a Microwave Assembly Plant

Paulo Moisés Godinho Feitosa
paulomoiises@hotmail.com
FAMETRO University Center – Brazil

David Barbosa de Alencar
david002870@hotmail.com
Galileo Institute of Technology and Education of the Amazon – ITEGAM

Alexandra Priscilla Tregue Costa
ptreguep@yahoo.com.br
Engineering Coordination at FAMETRO University Center – Brazil

Manoel Henrique Reis Nascimento
hreys@bol.com.br
Galileo Institute of Technology and Education of the Amazon – ITEGAM

Abstract

Costs are indicators of the financial and economic health of a company, as they are part of the production chain and are therefore necessary for the manufacture of a product, but when extra costs are included in production profitability is compromised. This paper aims to present the reduction of scrap costs of imported materials, identifying the problems related to the product and its impact on the company. As specific objectives, it aims to understand the problems that occur for the amount of parts disposal; develop a containment and correction action plan; implementation of improvements to the inspection and receiving line. As a methodology, we used a case study in a microwave oven assembly plant, where technical visits were conducted by two leaders responsible for the assembly, inspection and receiving sector, where the collection instruments were performed. For the elaboration of the solutions we used the 5W2H tool and control chart to find the faults in the parts.

Keywords: Scrap; Production cost; Cost reduction.

1. Introduction

The industry gives rise to costs that vary according to production, the assembly sector is part of the production of a finished product, when failures and scrap are costs that cost the organization's final value and profitability, also compromising other parts of the business. The costs that make the company profitable, if they outweigh the profitability soon the company also compromises its profitability.

Scraps of imported products make a difference within the costs of product completion. By not taking advantage of these parts, unit parts costs increase significantly, reducing the profitability of each finished product. The high costs with these failed parts are present in the monthly closings and it is a management meeting agenda, as it has high manufacturing costs.

This article aims to present the reduction of scrap costs of imported materials, identifying the problems related to the product and its impact on the company. As specific objectives, it aims to understand the problems that occur for the amount of parts disposal; develop a containment and correction action plan; implementation of improvements to the inspection and receiving line.

As a methodology, we used a case study in a microwave oven assembly plant, where technical visits were conducted by two leaders responsible for the assembly, inspection and receiving sector, where the collection instruments were performed. For the elaboration of the solutions we used the 5W2H tool and control chart to find the faults in the parts.

2. Theoretical Referential

2.1 Competitive advantage in the industry

Over the past few years, companies around the world have gone through a series of transformations and innovations. First it went through a period of boom and expansion, with expectations of a bright, almost limitless future. After this period, consequently, an era of crisis and deep frustration set in when, at the beginning of the 21st century, a strong economic slowdown ensued, leading to a global crisis. Business got a lot more complicated, especially in the industrial sector, which was easy before, became very difficult and needed immediate repairs, strategic breakthroughs in order to deal with these new challenges. Also, according to the author, the secret to permanent success is operational excellence, that is, one must invest in strategies focused on production, technology and sustainability, always avoiding waste. In order to achieve this operational excellence and survive in this new competitive environment, companies were forced to adopt new strategies and new patterns of relationships, including the Production Strategy [1].

Thus, it is understood that with the intense existing competitiveness, companies from different sectors, but with emphasis on the industrial and production sector, are disposed to improve the productive processes, making them more efficient through the reduction of activities that do not add value and generate costs [2]. Thus, eliminating waste became a joint action of all stakeholders that the company can continue to be active in the market, because the reduction brings other details that makes it sustainable, by collaborating with the environment, where the value of total quality the product becomes better, thus becoming a competitive differential for the company [3]. With this, the organization is better able even to make new negotiations because their prices will have margin for it.

In this context, the electronics industry in Brazil, for years, has provided great growth in product sales. Among the main factors that motivate such increase are: the diversity of functionalities of the produced equipment, the reduction of the useful life, the reduction of the final cost of the product and the technological innovation [4].

By conducting a thorough analysis of the consumer market, it can be seen that there has been a change in customer behavior and satisfaction, where they have new quality criteria, where they become more

demanding regarding price, quality, access, availability and also the sectors that involve the company's commitment to reduce consumption by worrying about waste [2].

As a competitive differentiation proposition, an organization's sustainability defines actions and activities that are geared to supplying needs without having to use more inputs or having to discard products in inappropriate places in order for material to be harnessed. In the best possible way, sustainability is directly intertwined with economic development without harming the environment, with both material disposal and overconsumption. Acting responsibly, taking advantage of products and inputs so that you do not have to dispose of them improperly or unnecessarily [5].

2.2 Cost reduction in production

In a survey conducted, it was noted that the company one company had many additional costs due to the waste generated in the manufacturing process of a white goods assembler (treated by appliances in general), noted the need to develop a focused work reducing scraps, which are treated as defective parts. These wastes are production elements that do not add value to the product, add costs and time to the execution of activities. To effectively reduce waste, methods proposed in accordance with Lean Production concepts are proposed, focusing on identifying and eliminating waste in order to reduce costs and increase quality and speed of delivery to the customer [2].

Within production, lean approach is based on the just-in-time method, which is when the right parts needed for assembly reach the line at the right time and in the right quality, reaching the ideal state of zero stock, is grounded. eliminating all waste in order to develop a faster, more reliable operation that produces high quality products and services and, above all, operates at a low cost [6].

Lean Manufacturing, is another process used to reduce waste that has its origin in the Toyota Production System is an initiative that seeks to eliminate waste, exclude what does not add value to the customer and convey agility to the company [5].

To effectively eliminate waste, it is necessary to investigate and make a general survey and find out where the precise source of the problem is, which can be accomplished through lean production tools. Thus, the main tools used to implement the principles of the Lean approach are mainly Value Stream Mapping and Lean and Kaizen Metrics [2].

The activities proposed by the kaizen method are directed to the work done by small groups, organized as best as possible within the company to perform specific tasks in the work area, which are responsible for solving problems and making improvements. Also, according to Rotta (2017), kaizen are continuous improvement efforts, performed by all, and their central focus is the search for the elimination of waste.

According to Rother and Shook (2012), kaizen can be divided into two axes, which are flow kaizen and process kaizen, where their functions are, respectively, the focus on flow improvement and are directed at management, It involves planning and executing high-level improvements, and process Kaizen focuses on improving individual processes, eliminating waste, and is linked to teams and work leaders, where they involve modifications located at specific points in the production process.

2.3 Microwave

The Brazilian home appliance market is becoming increasingly crowded, and the major companies

operating in the country are investing and expanding their respective product lines. White goods include refrigerators, automatic washers, freezers, dishwashers, automatic clothes dryers, stoves, air conditioners and microwave ovens [2].

Thus, although the Brazilian white line market is managed by a few large companies, the number of manufacturers has been growing in the market. In order to increase their market share, companies have sought several innovations in their products, from the production process to the consumer public. For the businessmen, requirements such as flexibility, cost reduction, product quality and reliability and speed in meeting market needs are considered fundamental to business success. [1]. In order to achieve good results in these dimensions, companies have been developing various internal restructuring processes, from internal to external sectors of the company, in relationships with their customers and suppliers, and with new acquisitions to follow the new rules regarding safety and security. to the environment. Innovation and innovative capacity are characteristics highlighted by managers as decisive factors of competitiveness [2].

The operation and mounting profile of a microwave oven is classified, the essential part of the equipment for its operation is the magnetron valve, which is the microwave generator, it consists of a vacuum device which converts electric energy in waves. A constant potential difference is applied between the anode (which is a hollow circular cylinder) and the cathode. Electrons are accelerated from cathode to anode, but the presence of a strong magnetic field (produced by an electromagnet placed between the two poles) causes the electrons to describe a curved path and follow a spiral path, producing radiofrequency. Later, by a more complex mechanism, electromagnetic waves will emerge from an antenna placed directly over the anode. The produced waves will be guided by a waveguide to the cavity containing the material to be heated. The metal walls of the oven absorb very little of the energy. Most are reflected and dissipated in dummy load, which prevents waves from damaging the valve [4].

In this sense, the microwave oven is a device that over time, has become almost essential homes, due to its practicality, making the cooking time of food is much shorter than the time required by a conventional oven [1].

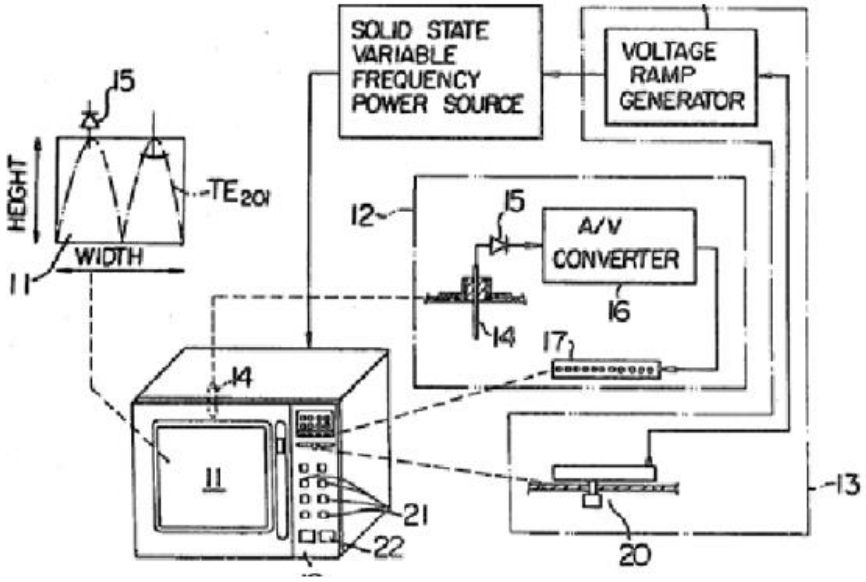


Figure 1: Microwave operation diagram
Source: Cacife (2010).

3. Methodology

According to a technical visit to a 30-liter microwave assembly plant, the observation and data collection was conducted as an instrument for collecting data through interviews to learn about the production processes that take place within the organization.

For all cost information to be ascertained it was necessary to carry out an in-depth mapping of the scraps, where the data were passed on to the control chart, pareto chart for visualization of failed waste and check sheet.

The research is inserted in a microwave oven assembly and manufacturing plant, where there are sectors divided according to the part of the product that needs to be assembled.

The sector studied is the revision sector, where the cover and door analysis of the product is performed, only after this inspection regarding the quality that is forwarded to the other sectors where the assembly will continue. For the planning of actions will be carried out planning using the 5W2H tool, from these actions proposals can be implemented.

4. Applied Studies

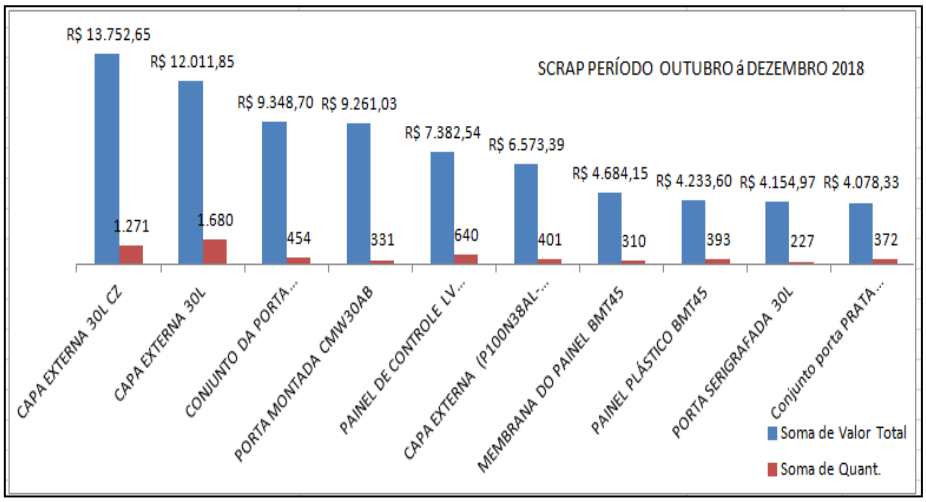
The inspection and receiving sector use two imported parts to assemble the product, these parts correspond to the cover and the door of the microwave oven. These parts arrive in a container and are stored in the factory stock, from where every morning is passed on to the revision sector to be able to go to the finishing sector. To list the fault quantities, tools such as control chart and check sheet were used.

4.1 Problems Identified

The research was carried out in the assembly line 18, where through the application of the collection instruments it was possible to observe the problems that increase the internal cost with parts at the moment of the product assembly. The company specializes in microwave oven manufacturing and is located in the city of Manaus. During the visit and observation period, the main flaw that causes the quantity of discarded parts to increase is directly linked to the quality.

Lack of knowledge about acceptable failure quality acceptance standards meant that several Scrap pieces were discarded every day because they had characteristics that were unknown if they were acceptable. The collaborators in doubt regarding the aesthetics of the pieces discarded them, increasing the cost of each piece, which in turn was purchased from China for a low price, but when turned into scrap the unit cost consequently increased.

By investigating the cost burden on each component in the assembly control worksheets, taking into account what is used in the overhaul sector, the items such as cover, door and panel are the ones that present the highest cost increase. in manufacturing within the list of ten costly components in the 30L microwave oven assembly line, as per Graph 1.



Graph 1 - Higher Inspection and Receiving Costs
Source: Author, 2019.

According to the graphic above, it can be observed that the procedure of discarding parts that apparently are not useful for assembly causes new parts to be purchased, making the cost higher for each production. In 2018, when the parts supplier had improved quality, but with scrap it still showed high costs on parts. However, in the year 2019 with the switch to a Chinese supplier that presents parts with
However, the company has two shifts composed of 12 hours from Monday to Friday, where a cover piece is assembled every 6 minutes, and a door every 5 minutes, considering that the value of the cover pieces 30L and Door Mounted are, respectively, $ 5.80 and 7.80. When observing the line, it was found that for each assembled part, two are discarded. Thus, 10 covers per hour and 12 doors per hour are assembled, if for each assembled piece two are discarded on average, so the current costs with discards from October to November / 2019 are R $ 2515.00, equivalent to 18.18% of the total value. That is, of the 1271 pieces of the 30L CZ outer shell in this period, 233 were discarded; Of the 1680 pieces of 30L Outer Cover, 305 pieces were discarded. Of the 454 Door Set pieces, 82 were discarded; Of the 331 doors assembled, 60 pieces were discarded in this selected period.

4.2 Control Chart

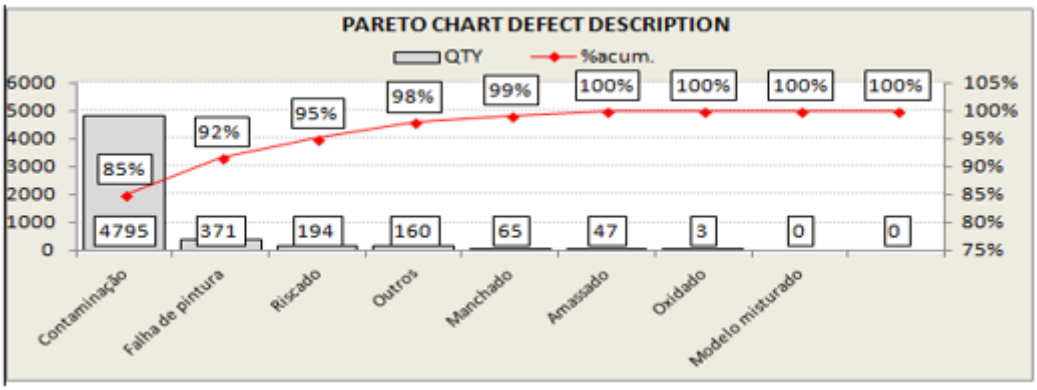
By observing the internal processes that focus on the disposal of waste in the assembly, it is possible to ascertain the main characteristics that motivate the disposal of parts when surveying and mapping the assembly process using a control chart. , as can be seen in Figure 2, below.

NAME:	MODEL:	DATE:	TOTAL REVISED:
RE:	CODE:	PO:	

Defects	07:00 às 8:00 17:00 às 18:00	08:00 às 9:00 18:00 às 19:00	09:00 às 10:00 19:00 às 20:00	10:00 às 11:00 20:00 às 21:00	11:00 às 12:00 21:00 às 22:00	12:00 às 13:00 22:00 às 23:00	13:00 às 14:00 23:00 às 00:00	14:00 às 15:00 00:00 às 01:00	15:00 às 16:0 01:00 às 02:2
Scratched									
Rusty									
Smoothie									

Figure 2 - Part Fault Control Chart
Source: Author, 2019.

From this it can be seen that the main problem found in the pieces is equivalent to scratched, oxidized, dented, mixed models, stained, contaminated, with paint failure, and other deformities that were used as a discard criterion. In the data collection performed through internal control spreadsheets, the main impacting failures in the sector are clearly and clearly represented by Graph 2, below:



Graph 2 - Pareto of the demonstration of major defects in parts
Source: Author, 2019.

Based on the statements, it can be known that the main reasons for discarding are contaminated or failed paint parts. This factor has been found to be constant due to the choice of the supplier, who in turn offers a larger product for a lower price, that if the losses are taken into account, the unit price is similar to the costs offered by suppliers offering parts with better quality.

4.3 5W2H

In order to elaborate an action that could offer the reduction of costs related to the assembly, observations were made in the parts, price knowledge, creation of new criteria that could use the parts that present insignificant flaws. This process was only possible with the presence of a person in charge of the assembly line, who presented the entire process, and it was possible to find the reasons for the increased costs with SCRAPS and the elaboration of the action plan.

Table 1 - Action planning

WHAT	WHY	WHO	WHEN	WHERE	HOW	HOW MUCH
Quality Management Training in the Sector	Increased knowledge by sector managers	Leaders and managers	20 days	In the sector	Inspection	$ 500.00
Elaboration of criteria for the acceptance of parts with small defects.	Acceptance of minor mounting failures	Mounting Sector	When selected defective parts	In the sector	Line	Free of charge
Implementation of 8D methodology.	Parts Testing Application	Assemblers	At the time of knowledge of part failures	In the sector	Line	Free of charge

Source: Author, 2019.

5. Results and Discussions

Through the cost analysis with the discarding of the pieces were made new analyzes aimed at the cost reduction. However, by applying the 8D methodologies it was possible to select the parts and define the problems that are found in them, it was necessary to contain this problem through a solution focused on the feasibility of using parts that have flaws that can be disregarded at the time. of the assembly.

Based on this, new criteria for the use of covers and doors were elaborated, where they were defined as:

1) Provided there is no definition of the technical drawing, the definitions of the visual inspection areas are defined according to the consumer's interface with the product. For high gloss parts they should be considered Class A.

2) Area A: All regions of the product or component which, in the most common installation position, are extremely visible from the consumer's point of view, usability, or specified in technical design;

3) Area B: All regions of the product or component which, in the most common installation position, are highly visible from the consumer's perspective or specified in technical drawing. Usually considered upper, lateral and other peripheral regions of the product.

4) Area C: All regions of the product or component which, in the most common installation position, are moderately visible from a consumer perspective or specified in a technical drawing. Usually considered the sides and backs of the product.

		ÁREA: A			ÁREA: B, BR e BL			ÁREA: C, CR e CL		
Pontos	Contraste	Tamanho do defeito	Quantidade aceitável	Distância mínima entre defeitos	Tamanho do defeito	Quantidade aceitável	Distância mínima entre defeitos	Tamanho do defeito	Quantidade aceitável	Distância mínima entre defeitos
	Sim	<0,5 mm	1	-	<0,5 mm	2	150 mm	<1 mm	2	250 mm
	Não	<1 mm	1	-	<1 mm	2	250 mm	<1,5 mm	2	150 mm
Amassado: Côncavo Convexo	Sim	<0,5 mm	1	-	<0,5 mm	2	150 mm	<1 mm	2	250 mm
	Não	<1 mm	1	-	<1 mm	2	250 mm	<1,5 mm	1	-
Riscado		Espessura	Comprimento		Espessura	Comprimento		Espessura	Comprimento	
	Sim	<0,5 mm	<2 mm	1	-	<0,5 mm	<4 mm	1	-	<0,5 mm	<8 mm	1	-
	Não	<1 mm	<4 mm	1	-	<1 mm	<6 mm	1	-	<1 mm	<8 mm	1	-

Figure 4 - List of acceptable criteria
Source: Author, 2019.

After these criteria about 5 employees were summoned to perform the visibility test by the consumer. Thus, a distance was established for the evaluation, taking into consideration the possible view that the consumer may have of parts that have some kind of failure, whether or not perceived by the target audience.

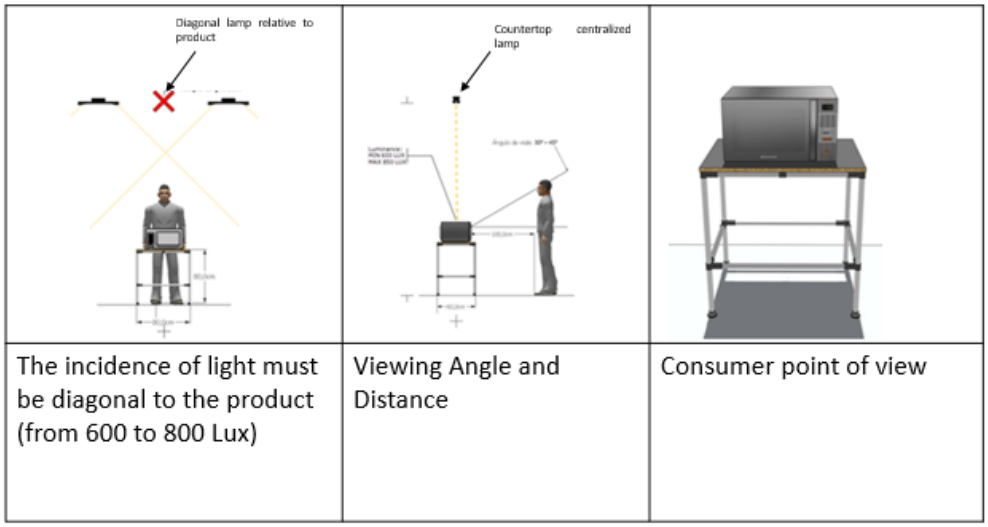


Figure 4 - Position in which the tests were performed
Source: Author, 2019.

It was found that the parts do not emphasize acceptable details, and some details on the covers are imperceptible, and thus, the parts that were within the fault visibility criterion were no longer discarded, but used in the assembly.

As a result of this new acceptance of parts, disposal has reduced on the assembly line. The number of pieces that were definitively discarded dropped to an average of 5 pieces per shift for both cover and doors. If the company maintains this result, the amount of unused failures discarded is a margin of 220 monthly pieces, which cost an average of 6.00, making it approximately $ 1,320. Before the changes, the costs with losses averaged R $ 2,515.20, leading to a cost reduction of 52.48% in the number of SCRAPs from September to October 2019. The statement of this result in the economic scope of the company is evidenced according to Graph 3.

Graph 3 - Comparison of part quantity
Source: Author, 2019.

6. Final Considerations

According to the studies raised in the process of assembling the microwave oven factory, it can be observed that the cost of unused parts can compromise a considerable part of the variable costs of the organization, causing the company to have a reduction in profitability and may even compromise the financial health of the business in future times. Employees' commitment to quality and better use of inputs brings significant returns to the company.

The lack of knowledge about the norms and criteria of acceptance of the parts and actions aimed at the visualization of the finished product made the parts accepted as inputs and could be used in the assembly line, not requiring the purchasing or quality sector to come into contact. Contact your overseas vendor to reach a consensus on re-billing as this would take time and cost.

Just one organization, applying the 8D methodology was enough to make the quality and assembly team reach a criterion where it does not compromise end customer satisfaction.

As a result, the results were impressive because more than half of the parts that were previously discarded started to be used in the assembly and the quality remained the same. It can be considered that the scrap or discarded parts in the production process and how much the unit cost of the purchased parts will be taken advantage of will become lower as their use increases and it makes sense to buy low priced parts from the Chinese supplier.

It is suggested new studies focused on the field of use of failed parts where they can be 100% used, because in this study only those parts that were within the new acceptance criteria that became part of the assembly line, the parts significant defects continued to be ruled out.

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