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KAIZEN TOOLS FOR PRODUCTIVITY IMPROVEMENT: A Real Case

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KAIZEN TOOLS FOR PRODUCTIVITY IMPROVEMENT: A REAL CASE

Abstract. *It is shown how that the establishment of Kaizen tools can greatly improve the productivity of a Company producing mobile phones. This action-research made a diagnosis of a single assembly line to serve as a prototype of a companywide project, selecting a team to deploy the Kaizen tools as well as a 5S policy, leading to standards of all operations needed for the completion of high quality handsets. Throughout this article, a critical view of the entire development process, enhancing actions necessary to actually improve all steps necessary in the assembly lines operations. The prototype line was completed, and all the standard operations recorded in order to disseminate this knowledge over all assembly lines.*

Keywords: *5S, Assembly lines, Knowledge management, Mobile phones, Standardization.*

1. INTRODUCTION

The choice of a company for a given production system is the result of a strategic decision based on goals and on market assessment. The form of management will affect the production system performance in its competitive aspects such as cost, quality, delivery speed, reliability and flexibility. The success of a production system depends on a number of factors such as structure, human resources, level of automation and management system. In itself, the implementation of a manufacturing management system does not guarantee the competitive success of the company (Correa and Gianese, 1996).

Capitalism, in its history, faced many crises that have transformed the way of organizing production and social life. From the 1970s, attention was called into questioning an entire mode of organization of society, production and politics, characterized by Fordism in the productive sphere and the state of social well-being in developed countries.

The capital was to respond to such a crisis with the restoration of their profit rates through changes in the productive sphere and the market. The tactics the capital, with the state support, used to respond to this crisis were named, generally, productive restructuring - a phenomenon that significantly changed the way of organization of production, the labour market and the subjectivity of workers (Andersen, 2009).

The term "productive restructuring" houses several processes that take specific national forms, as well as sectoral and regional. Among the processes that the productive restructuring phenomenon houses, stands out the spread of Japanese production model, whose lean manufacturing is one of its elements (Fukui and Ushijima, 2007).

Lean Manufacturing (Lean Production) is the name given to a new system of production or production paradigm that originated in Japanese industry, specifically in the Toyota Motor Company, from the work developed by Taiichi Ohno (Ohno, 1997) and Shigeo Shingo (Shingo, 1996a, 1996b) engineers in the 1960s.

The Lean Production received increased attention after the oil crisis in 1973, when Toyota began to produce a greater variety of car models, but in small quantities. These measures have preserved the company from the effects of the crisis and to become competitive and efficient. Lean Production System aims at improving the production process by means of combating sources of waste, namely the elimination of which is unnecessary when the production cycle and the alignment of generating activities value. In this scenario, the production is driven by real consumer demand rather than by market projections (Womack and Jones, 1996, 2004).

The concept of Lean Production was conceived in the final years of the 1980s by researchers at the International Motor Vehicle Program (IMVP), developed by the Michigan Institute of Technology (MIT) in order to develop a more efficient production system, flexible, agile and innovative that could face an ever-changing market (Ghinato, 2000).

The Toyota Production System (TPS) is seen not only as a set of methods and rules, but also as a new philosophy of production that seeks to optimize the organization to meet customer needs as soon as possible, with high quality and low cost, while that cares about the morale of his team, involving and integrating not only manufacture, but all parts of the organization (Ghinato, 2000).

The company is experiencing a real competitive period generated by the effectiveness of the performance of companies, not only by artificial fluctuations of exchange. In this context, one of the tools for better business performance is the adherence to the principles of lean manufacturing, to maximize the use of resources and production processes, waste reduction and elimination of unnecessary work (Iron, 2002 *apud* Prado, 2006, p. 20).

According to Liker (2005), the main reasons for the adoption of the philosophy of lean manufacturing are its low investment costs and the generation of high gains in volume of material, reduced cycles and greater integration and commitment between the various production areas.

Today, business owners think the best way to achieve this goal quickly, without forgetting its social and environmental responsibilities. However, for the implementation of lean manufacturing becomes effective a change is required in the company culture and the involvement of all employees, not just formal and bureaucratic changes. In fierce competition times throughout the competitive edge must be implemented to ensure the company's survival. In this globalized world, the value-added services and products disappear faster and faster due to the high speed that create new technology. Thus justifies the importance of having an effective governance to ensure more intelligent processes and enable their continuous improvement and for that a different

approach needs to be deployed in order that the organization has an extra element in the market, i.e. which is its internal organization has a competitive edge.

Companies using these concepts are market leaders and increasingly able to reduce their costs and improve the quality of its processes, products and services and consequently transmit systematically to their clients, the values that cause them to be faithful your brand.

The electronics industry as presented in this work have experienced a high degree of dynamism and competitiveness, due to technological modernization, the demands of consumers and the intensification of global competition. Therefore, the industries in this segment are increasingly adopting practices that make them more efficient. In this context, adherence to lean manufacturing is present and necessary (Meade and Rabelo, 2004).

This study seeks to show that the Kaizen methodology is a powerful tool for continuous improvement in a mobile assembly line, making it more productive and more profitable through a reorganization of the production process and changes in company culture.

This action research presents the implementation of lean manufacturing philosophy, in particular the applicability of the Kaizen methodology, 5S (Osada, 2002) and standardization for this type of production, and proposes alternatives under that methodology. According to Bhuiyan and Baghel (2005), the application of Kaizen methodology or process of continuous improvement, mean important tools in identifying opportunities to eliminate waste and improve productivity and the quality of processes and, according to Santos et al. (2009), as the Kaizens are performed, it spreads the model of the culture of lean production in the company.

The work started by analysing the literature on models that make up the methodology, to support with information to guide this work, which culminated with the completion and presentation of standardization of case study with Kaizen and 5S with productivity improvement goal in company the electronics industry.

This study aimed to introduce techniques and methods to improve efficiency and reduce waste in a mobile assembly line, through the implementation of management principles of lean manufacturing.

The specific objectives, this approach focuses on:

- Review the application of the tools of lean production methodology in a mobile assembly line;
- Check and compare the data of the variables observed in the production process;
- Perform layout studies the assembly line;
- Diagnose through value stream maps, the current state of production, identify waste and propose ways to eradicate them;
- Conduct studies of best practices;

- Validate the implementation of lean manufacturing tools and propose new practices.

Research and improvement project were implanted with Kaizen methodology for standardization in the Cell assembly line, it is an area of production and testing. The development project was set up to the implementation phase, limited to set a management plan and process standardization to other lines.

For this work, the case study was adopted, which, according to Yin (2001, p. 27), is used as a research strategy that can be combined with experiments, data surveys, historical research and information analysis files.

The case study is a suitable method when the phenomenon under investigation is in a context of real life. In this study, we adopted the classification by Diehl and Tahtim (2004), which is organized under the following rationale research: Problem approach, general purpose and technical procedure.

Therefore, as the objective of this study is classified as has been said, as an action research as its main characteristic the adoption of empirical research, designed and built in close association with an action or solving a problem, with which researchers and participants representative of the situation are involved in a cooperative and participatory way.

This action research made it possible to define, measure and standardize all variables inherent in the cell assembly process. They were used as tools and methods of results of questions posed analysis of all the factors involved, and analysis and implementation of improvements. Initially, there was a literature review on lean manufacturing and its key concepts and principles, as well as reading material for the electronics industry.

To collect specific data were carried out various activities based on the familiarization process with Korea the assembly process in its various stages, with the accompaniment of Koreans to investigate the process flows.

Due to the particularities of the production system in question, it was proposed a new applicability of lean manufacturing that was not already known to the metallurgical and automotive sector, focusing on continuous improvement. After the implementation of the proposed changes, compared to production efficiency before and after and found up the benefits patents in the adoption of new practical proposals.

This research reversed the traditional investigative process in the area, because began the study by value stream maps of the current state and future; however, it investigated the particular process to be fully assimilated, just to propose necessary improvements and real.

2. THEORETICAL FRAMEWORK

Benevides Filho and Tubino (2001) point out that economic globalization increases competitiveness

by demand for products and consequently leads companies to review their production systems, requiring new forms of work organization that enable minimization of costs, quality, delivery speed, reliability of deadlines and flexibility. And within this context that the man, through the figure of the operators, plays a significant part in this process. Based on these considerations the application of Kaizen methodology used by operators on the shop floor can provide several benefits mentioned by the authors above.

According to Briales and Ferraz (2005), an interesting strategy adopted by some companies are improvement tools remains the Kaizen philosophy. As its objectives the elimination of waste based on common sense, the use of inexpensive solutions that draw on the motivation and creativity of employees to improve the practice of their processes. This tool became known because of its application in the Toyota Production System. He was to mastermind the Taichi Ohno engineer, in order to reduce waste generated in production processes and promote the continuous improvement of product quality and increasing productivity.

According to the results presented by the authors Moraes Silva and Turrioni (2003), concluded that the Kaizen philosophy is widely applicable in the automotive industry and other industrial branches and in our daily lives, obtaining results of extreme success, several logo Companies are using this philosophy.

According to Araujo and Rentes (2006) the Kaizen philosophy, conducted in a structured way, fighting up the real causes of the problems, and linked to a strategic vision of future situation ideal, it becomes a dynamic and sustainable tool for driving change in the processes.

The Kaizen methodology, from the point of view of the Kaizen Institute (2009), is responsible for the implementation of a new paradigm of work organization focused on the creation of free-flowing materials and information, work pulled depending on customer requirements, zero defects and zero accidents. Organizations can implement this methodology reach extraordinary competitive advantage and managed to achieve a high level of operational excellence.

The context of the Kaizen methodology used in this case study, important as it now becomes this concept is assimilated, practiced and disseminated by companies, by virtue of awareness of the constant improvement of the processes is a competitive advantage, then organizations create or deploy existing systems of continuous improvement, following or not an existing methodology. This fact demonstrates and confirms the concept of Martins and Laugeni (2002), which ranks as a world class company that takes as its strong feature, the use of the concept of continuous improvement in its processes.

The Kaizen consists of some concepts and techniques: Focusing on the consumer, Total Quality Control (TQC), Quality Control Circles (QC), suggestion system, automation, discipline in the workplace, MPT? (Total Productive Maintenance), Kanban, quality improvement (zero defects),

Just-in-Time, small group activities, cooperative relations between management and labour, work, improving productivity and developing new products and processes.

As Sharma and Moody (2001), the macro view of the Kaizen philosophy deals with strategic issues for the manufacture of quality, cost and delivery. In this approach, it takes into account how to improve the quality, how to control the cost and how to ensure the delivery of applications. The kaizen philosophy is focused on strategic versus time operations. Thus, a reduction in time results in reduced delivery time, improved reaction of manufacture, improvement in delivery performance and minimal obsolescence of stock.

The Kaizen methodology has the following features to optimize work to improve processes: focus on clear objectives; work processes and teamwork; prioritize the time to obtain results; use creativity and avoid overspending in the application of ideas; act quickly together with the simplicity and use available resources needed. Projects are executed in a week where disputes requiring longer have the time limit of 30 days, and participation should be multifunctional. There are no traditional hierarchical levels that can meet the spontaneity of the people who make up the group. Creativity and group initiative are encouraged and improvements are implemented through standard changes work. At the end of each Kaizen shows the results for the company (Corrêa Netto and Vieira, 2008).

Regarding the implementation of continuous improvement processes, we see the existence of forms of organization, but you must choose an existing methodology or create an appropriate methodology to the processes of the organization, or even hiring specific consulting. One way of applying kaizen methodology used and known today, is the method of a week, as shown in studies of Correa Netto and Vieira (2007) and Araujo and Rentes (2006).

3. PROPOSITION

The motivation to carry out action research reported in this study was the observation of low productivity and quality of mobile assembly lines of a company where such research was taken effect. The result was the loss of market, mainly due to increased agility competitors in the delivery and performance of the cell. To achieve the proposed purpose, it was established that the tools of lean manufacturing were the most appropriate. This was done and the results were more than satisfactory, as shown in the following chapters.

4. METHOD

The work done in the study of the object can now be classified as type action research as clarify Turrioni and Pereira Neto (2012). According to these authors.

An action research is a type of social research with empirical basis, which is designed and built in close association with an action or resolution of a collective problem and in which researchers and participants of the situation or problem are involved in a cooperative and participatory way. [...] The term research refers to the production of knowledge and the term action refers to an intentional modification of given reality. [...] In this method of research, knowledge is produced and the reality is modified simultaneously, each occurring due to the other. [...] Action research is a research strategy in production engineering, which aims to produce knowledge and solve a practical problem. [...] The main characteristics that define the action research are:

- Use of scientific approach to study the resolution of important social or organizational issues along with those who experience these issues directly [...];
- Members of the system being studied participate actively and cooperatively with the change agents (researchers) in the cyclic process mentioned above;
- It includes iterative cycles of data collection, feedback such data for those interested, data analysis, action planning, taking action and evaluation, leading to new data collection, and so on [...];
- Ideally, it is expected that driving of research is in real time, although a retrospective investigation action is acceptable.

In the case of action research conducted, it was certainly the Practical kind because the goals were the effectiveness / efficiency of the practice and professional development, understanding of practitioners (co-workers on the assembly lines) transformation of consciousness practitioners (environment work and commitment). The role of the researcher, author of this work, was certainly Socratic, encouraging participation and self-reflection, ale to choose and / or protect the changes made. Regarding the relationship between researcher and participants certainly TVE characteristic of cooperation, i.e., constant communication (Tripp, 2005; Zuber-Skerritt and Perry, 2002).

The scientific approach was constituted in relevant research papers published in journals and books, and references available on the web. Reading this material was consolidated knowledge of this researcher, concluding, as already announced, the situation (productivity and quality) could be addressed by traditional tools of lean manufacturing, unpopular in the industry where the company, the object of study. The project to be implemented included the opinions of active employees in the mobile assembly lines. All information and data collected processed form, returning to previous activity in case of non-compliance with the reality of the situation. In order to research and the resulting actions were carried out in real time.

This method effectively resulted in the changes needed to achieve significant improvements in productivity and quality, and produce a positive impact in the workplace.

5. RESULTS

Action research carried occurred in stages: identification and results are described below.

5.1. Company diagnosis

The company studied is a global company, a provider of solutions and innovations with the mission of world develop products that are adapted to people's lives through a perfect blend of smart technology and stylish design. The company's goal is to create products with the highest digital technology and innovative services to make life more comfortable and convenient consumers. Currently the company has over 84,000 employees in 115 operations including 84 subsidiaries in more than 40 countries, working with five business units: Mobile Communications, HomeEntertainment, Home Appliance, Air Conditioning and Business Solutions. The mounting mobile devices in the company under investigation is linked to mass production mode, although its machine park is modern and short time of use, lean manufacturing is required and also spread to other industrial and business sectors in general. But some segments joined little by this style of production or, in some cases, adopted only some of their practices, with mediocre results. In the company studied the internal audit resulted in numerous problems, causes, directly responsible for the effects observed in the company's operations. The principal were.

5.2. Waste of overproduction

There were waste to produce ahead of demand, in case the products are ordered in the future (T + 1, T + 2, T + 3), that is, the principle of Just-in-Time was totally ignored.

5.3. Waiting waste

It was the stuff that was waiting to be processed, queuing designed to ensure high utilization rates of equipment and accessories. This, in addition to producing unproductive bottlenecks, contributed to the high cost of intermediate stocks.

5.4. Processing waste

There is an inherent waste to a non-optimized process, namely, performing functions or process steps that do not add value to the product, values resulting from a lack of analysis in the production flow.

5.5. Movement of waste

There were present waste in various operations of the production process, resulting from the interaction between the operator, machine, tool and the work in process.

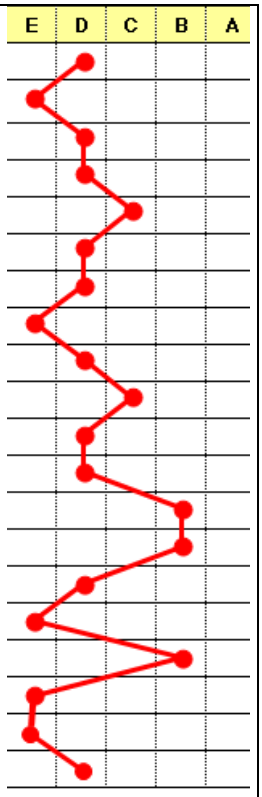
5.6. Lack of 5S plan

There was no 5S plan to map the important points of the completion of 5S, Checklist and a discipline for shares of employees. All this can be solved with the usual tools of lean manufacturing. Through internal audits and address a large number of low quality and productivity at the end of the process, it was found that the organization had the problem of lack of standardization, waste of excess and lack of a program 5S. Be verified by Table 1, the result of the last audit are shown in Table 1.

The result presented here is based on criteria that are conducted monthly by a newly formed team with former to check, analyse and make the necessary improvements. Table 1 show the general results in the last three months.

Table 1. Last search audit

Items /Score			E	D	C	B	A
Clean-up steps	**5S**	5S Plan					
		Selection and Discard					
		Organization					
		Neatness					
		Hygiene					
		Discipline					
	3R	Right Place					
		Right Quantity					
		Right Recipient					
	Visual Control	Production Report					
		Standardization					
		Anomalies Indicators					
QA Systems	QA Think-about daily Meeting						
	Self- inspection and Sequential Inspection						
	Time Check						
	Critical Process Control						
	Fault Return						
	Line Audit						
Work Losses	Losses Decrease Improvement						
	Result Improvement						



6. DISCUSSION

This plant has the kaizen event as a routine management as from programming pre-defined continuous improvement coordinator and the industrial manager themes and events of kaizen teams are established that shall occur in the plant through a bimonthly schedule.

A multifunctional team is formed to participate in each kaizen, its duration is 5 days, which is considered a week of creation and implementation of improvements.

It can be seen from Table 2, the agenda a week Kaizen. The methodology was due to the need to adapt the productive resources of the company with the demand of a phone model and one assembly line and, upon approval, the methodology is standardized and replicated to other lines of Assembly and other models cell, below the details of each day of implementation.

Table 2. Predetermined routine for Kaizen events in the company

Step	Details	Who	Periods				
			05/28	05/29	05/30	05/31	06/01
Brainstorm	Annotation of Problems Identified	Guilherme Wallace					
Definition and Implementation	Team definition Improvements implementation	Guilherme Wallace - Improvement team					
Implementation	Improvements implementation Reports on results	Improvement team Guilherme Wallace					
Meeting	Presentation of activities executed during the week	Guilherme Wallace					

The methodology was due to the need to adapt the productive resources of the company with the demand of a phone model and one assembly line and, upon approval, the methodology is standardized and replicated to other lines of Assembly and other models cell, below the details of each day of implementation:

(1) First day: identify the problem - The first day was defined line 1 and the phone model E400 which were identified in the process all the problems such as dirt in equipment; countertops and flooring; process materials and without default location tools and demarcation; Wiring disorganized equipment and may cause accidents of electric shock and fire; mobile repair

benches without signalling in case of failure without emergency button on the line; without standard drive belts; unnecessary movement of employees in the process; disorganization of materials in process; excess leaves no work order instruction in the line;

(2) Second day: establishing team - were established team members for conducting the work following the criteria as interface areas, and degree of relationship with the problem. They picked up the representative of the production as a leader, process engineering, machine operators, production assistants, maintenance and with the help of an external consultant (Korean). Figure 1 depicts the improvement team in the implementation of Kaizen;

Figure 1. Improvement team in the implementation of Kaizen in assembly line 1

(3) Third day: Physical Changes, point Kaizen, test and measurement, evaluation of results, additional improvements, standard operations. Table 3 shows the activities with those responsible for each activity improved.

Table 3. Schedule of activities with those

Item	Details	Leader	Status
1.1 Work Instruction	= Work Instructions support alteration	Pablo	
	- Assembly Line Work Instructions allocation definition	Gwang	
	- Grouping Work Instructions with sequential Instructions	Diego	
	- Grouping Instructions with similar information	Diego	
	- PCV Trays Installation		
	- Cabling organization		
	- Assembly Line frequencies inverters installation		
	- Ionized Line nozzles settlement		
1.2	- Welding Iron Source location alteration		

Cabling	- Conveyors Inverters installation	Team	
	- Scale Light Indicator height location alteration		
	- Installation of keyboard support and PIF 100 in OQC Bench		
	- Installation of Light Signal of Sequential Failure		
	- Ducts change in order to avoid Components Failure		
1.3 5S	- Move from Brooms to Powder Vacuum C leaner	Field Team	
	- Leaders meeting for neatness with check-list	Francisco	
	- Meeting with Assembly Line Workers	Leaders	
1.4 Demarcation and Signalling	- Work Floor and Surface Demarcation	José Paulo	
	- 5S and 3R Charts		
1.5 Material organization	- Assembly Line Materials Identification	Team	
	- Reduction of Waste Recipients in the Assembly Line	Carlos	

Be First, Do it Right, Work Smart!

(4) Fourth day: Disclosure of changes, training in standard operations, production, proof of income, refinement of Kaizen (improvement), standard operations, visual control.

To carry out the activities listed above, it was necessary:

- Cooperation of all line employees;
- It was questioned and suggested suggestions with all responsible employees from their jobs a type of improvement for facilitating their work;
- Shopping Need material for 5S and 3R and supports;
- The finance department for release of purchases;
- Installation support and electrical wiring for maintenance;
- Line 1 release of produce for 4 days for implementation of improvements;
- Training for some types of more complex automation of improvements as mats.

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- Installation support and electrical wiring for maintenance;

- Line 1 release of produce for 4 days for implementation of improvements;
- Training for some types of more complex automation of improvements as mats.

Loss reduction also performed in the assembly process of identifying the bottleneck line as illustrated in Figure 2.

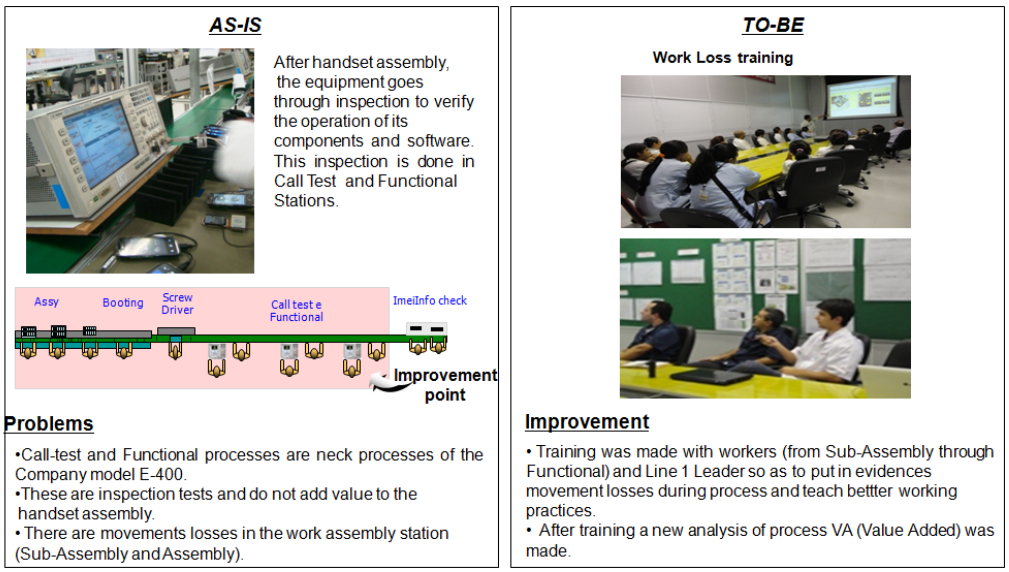


Figure 2. Loss Reduction in the Process and Functional Test Assembly Call

Figure 3 shows the 3R map (right place, right container and certain amount) line with the definition of standardization of each station of the line.

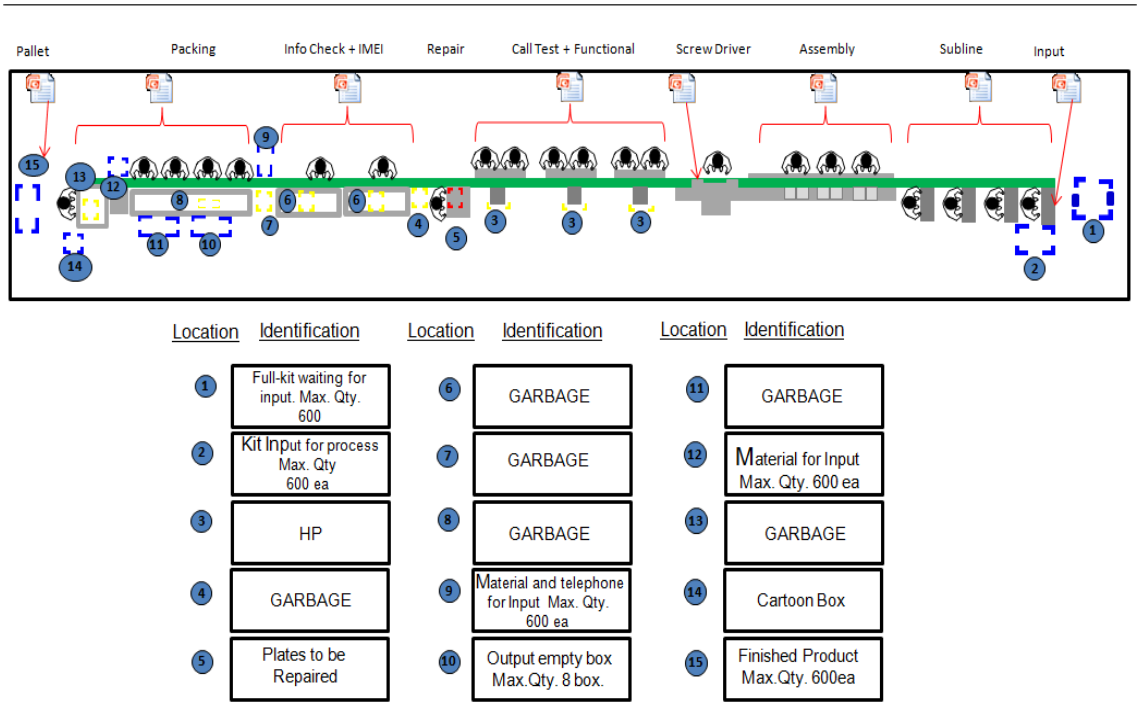


Figure 3. Assembly line map with 3R standardization Ids

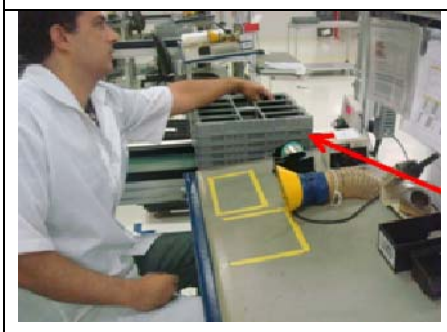
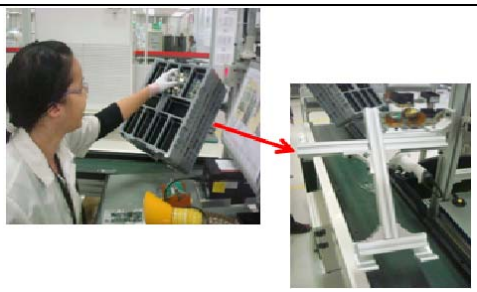
Among the various improvements made by Station, below is cited an improvement of each post as shown in Figure 3 on line map 3R.

Station 1: Organization icons on the PC desktop in line Input (Figure 4).

BEFORE		**AFTER**
		
Problem - Icons messup on Production Line Computers DeskTop - No clear shortcut for work instructions - No Warning to avoid icons criation, elimination or movement		Improvement - New wall panel - Unnecessary icons eliminated - Work Area Warning to avoid icons movement, addition or criation
Qualitative Gain - Visual - Work Environment Organization - Work Area Standardization		Idealizer - Improvement team

Figure 4. Improved Icons Standardization (Company Logo obliterated on purpose)

Station 2: Improved movements and ergonomics (Figure 5).

BEFORE		**AFTER**
	Tray located over convevor	
Problem - Unnecessary movement since tray is located far away from operator		Improvement - Supplying a movable support besides the table it is possible to put tray closer to the operator

Qualitative Gain - Visual - Organization of working environment - Ergonomics		Idealizer - Improvement team
		Quantitative Gain - Elimination of unnecessary movement - Decrease of work loss

Figure 5. Ergonomic improvement

Station 3: Organization and a better control of the material on line (Figure 6).

BEFORE		**AFTER**
		
Problem - Did not inform right material quantity and position		Improvement - Was criated a card informing maximum and minimum with correct material position
Qualitative Gain - Better line material control - Better line visual		Idealizer - Improvement team

Figure 6. Material Flow Improvement

Station 4: Materials Organization and a better visual on the spot (Figure 7).

BEFORE		**AFTER**

		
Problem - No identification and standard place for SD Cards, Screws and Fault Labels		Improvement - Identification and standardization of SD Cards and Srews. Clear position of Fault Labels Roll
Qualitative Gain - Better Table visual - Better Material Control		Idealizer - Improvement team

Figure 7. Visual improvement on site (Authors Note: Portuguese LIXO means English GARBAGE; Portuguese PARAFUSO means English SCREW)

Station 5: Call-test bench organized and standardized (Figure 8).

BEFORE		**AFTER**
		
Problem - Call-test Work Table unorganized and without standard marking		Improvement - Marked and organized standard place on table
Qualitative Gain - Better table visual		Idealizer - Improvement team

- Work place better work flexibility		

Figure 8. Call-test standardization

Station 6: Set the default location for cleaning material identification (Figure 9).

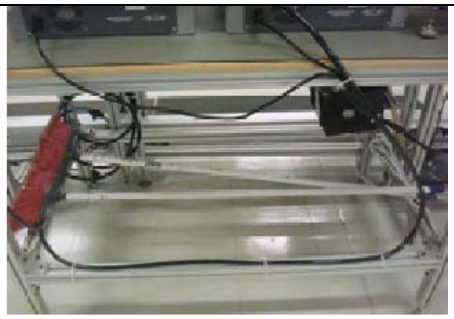
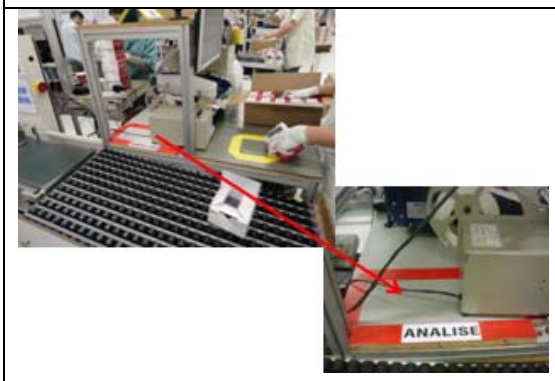
BEFORE		**AFTER**
		
Problem - Line cleaning material no standard place and no identification		Improvement - Line end standard position defined and cleaning material quantity and identification
Qualitative Gain - Line better visual - Access facility		Idealizer - Field team

Figure 9. Site Visual improvement (Author Note: Red arrow shows MATERIAL DE LIMPEZA (Portuguese), i.e., CLEANING MATERIAL)

Station 7: Set the default location for cell analysis at the bench kit (Figure 10).

BEFORE		**AFTER**
		
Problem - Kit analysis verification place		Improvement - Standard place established in table

obstructed by the equipment is limiting work room		upper part giving more work room
Qualitative Gain - More room available avoiding kit fall - Sector better visual		Idealizer - Improvement team

Figure 10. Standardization of material analysis

Also installed a flag (andon) as illustrated in Figure 11 to indicate the presence of sequential failures visually and sent a signal via network cable to the technician in charge and supervision for fast action generating a decrease in the number of phones with defects for repair.

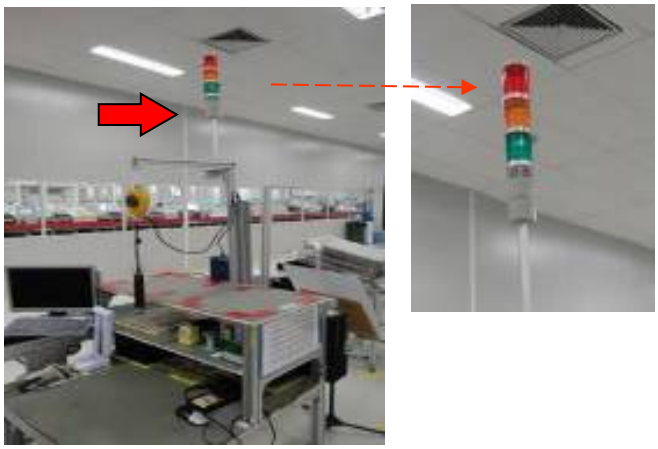


Figure 11. Sequential failures flag

Installed frequency inverters as illustrated in Figure 12 at all mats in place of the old controller, standardizing the same speed in all line tracks with a single controller thereby avoiding overlapping plates which generated flaws with an average from 10 to 13 plates per day with breaking components, now deployed automation reduced to 0 (zero) the number of failures gains for generating quality.

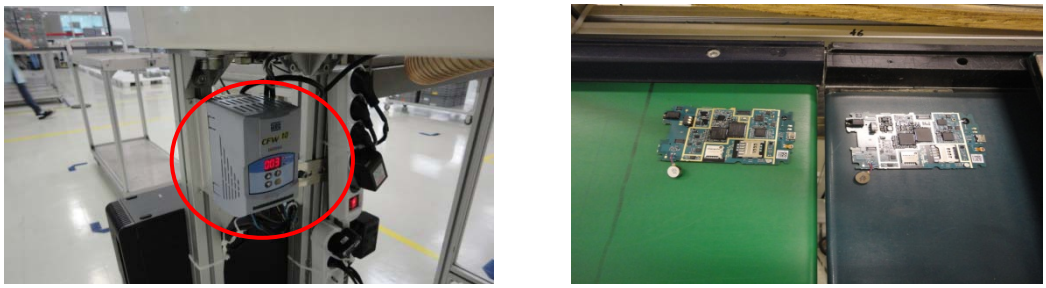


Figure 12. Frequency inverters and mats with plates

6.1. Information panel

Within the Clean-Up 3 Steps rules, one of the items of visual control was the creation of informative panel as Figure 13 with mission:

Figure 13. Information panel of Assembly Line 1

(1) Keep a production release.

- Updated and regularly documents on the line;
- Number of people per line
- The employees know in real time the status of production.

(2) Sharing the goals.

- Share the production and quality goals with all daily.

(3) Check-list of cleanliness by line and turn.

- The check is performed per day per employee from his post.

(4) Show the main processes.

- Identify the critical processes to quality (CTQ).

(5) Show defects.

- Mark the defect clearly in the process

(6) Indicators.

- Indicator abnormalities: Abnormalities in line
- Cleaning Placemark: map 5S
- Progress Indicator: Work Progress

(7) Keep track of abnormalities and the actions taken to fix the problem.

6.2. Results in numbers in the assembly line after the Kaizen

The movement of waste item (Figure 14) in the process in order to identify VA (value-added), BVA (added business value) and eliminate NVA (not value) make the improvement in the loss of work process flow, and where it was identified neck line. Table 4 shows the results obtained for the improvements achieved.

Figure 14. Assembly Line 1

Table 4. Qualitative and quantitative results

Part	**Current scenery**	**Result**
Work Instruction	Modified in order to publish instructions and unifying work instructions with sequential inspection	Before: 33 After: 10
Cabling	Tray Installation for cabling, facilitating maintenance, improving visual and safety	Visual 100%
5S and 3R	With support creation, reduced unnecessary movements and facilitated 5S maintenance	13 supports created
Demarcation and Signalizing	A standard map of 5S and 3R was developed for consulting and management	Before: 0 After: 100%
Material Organization	Identification established for standardization of operations realized during productive process	Before: 0 After: 20

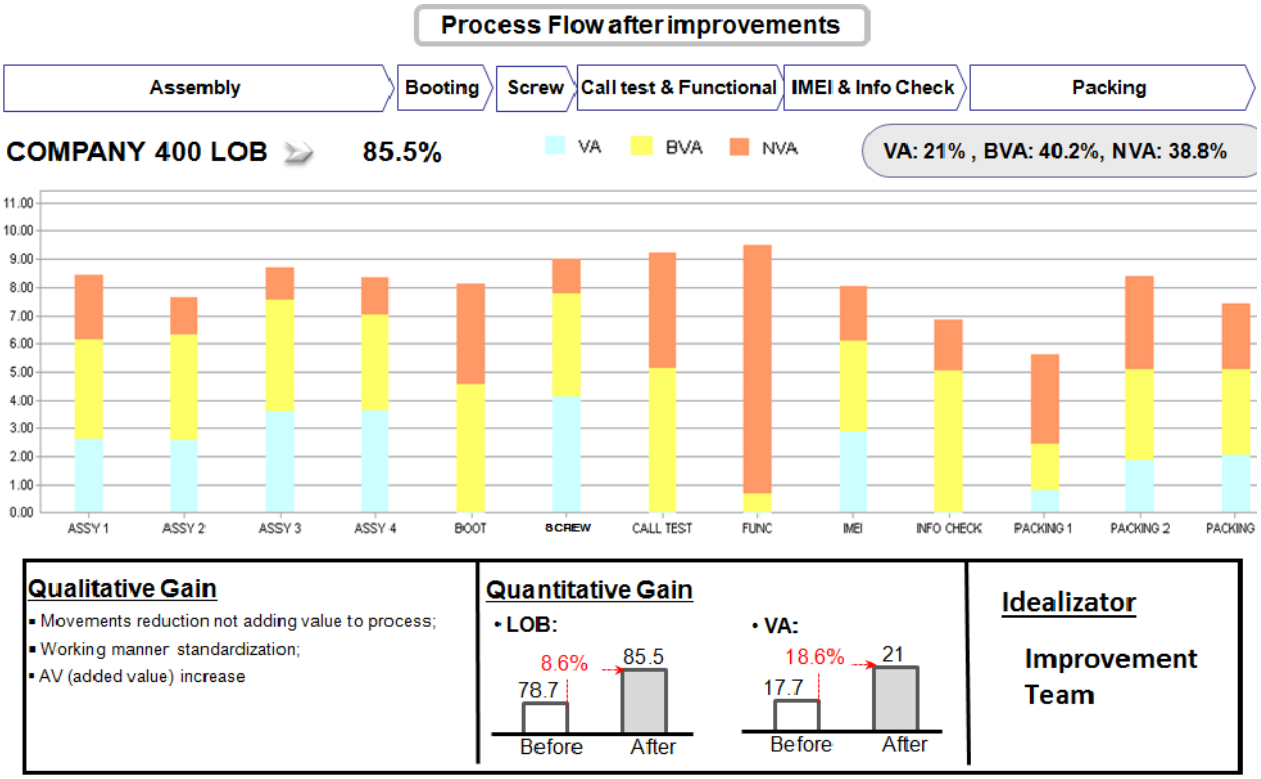


Figure 15. Improved result in the loss of work performed after implantation

Finally, Figure 16 illustrates the general result of Kaizen implementation.

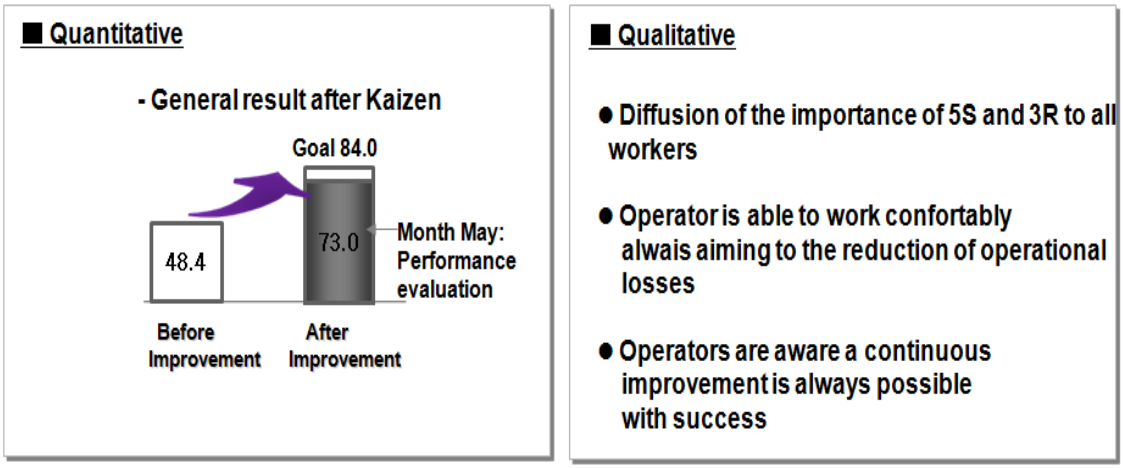


Figure 16. General result Kaizen

7. CONCLUSION

It was found that the choice of subject, the team and the commitment of managers, factors identified in the course of work, as important to the success of Kaizen are indeed essential if the objectives are achieved. Without the real commitment of the staff involved in the process, motivated by the leading figure, it would be impossible to achieve the goals. In addition to the changes implemented are actually kept the commitment of managers is needed. There has also been the need for the

objectives and goals are well set for the team to know clearly the actions that must perform and not be lost in the process.

You can still point to positive Kaizen appreciation of the participating employee, considering that, only from your ideas and suggestions becomes possible to apply this tool. Thus, the Kaizen participant feels important and fundamental part of the process may also contribute to the continuous search for improvements in their area.

Regarding the motivational factor is noticeable contribution of this work, because the members who were appointed to form this team felt recognized and valued, because they are the same ones who lead the production work in this feature, being more confident and secure, because Knowledge of the gains made in this appeal.

It was observed that the correct use of improved methodology continues whose main results in the potentiation of the results before the cases that do not use specific methodology. The number of shares that require a longer period for implementation demonstrates the importance of continuity of the continuous improvement program.

REFERENCES

Andersen, S. H. 2009. "Unemployment and Subjective Well-Being: A Question of Class?" *Work and Occupation* 36(1):3-25.

Araujo, C. A. C., and A. F. Flush. 2006. "The Kaizen Methodology in Conducting the Processes of Change in Lean Production Systems." *Industrial Management* 2(2):133-142. (in Portuguese)

Benevides Filho, S. A., and D. F. Tubino. 2001. "Successful Cases of Implementation of Versatility in Brazilian Industries." *Proceedings of the XXI ENEGEP*. (in Portuguese)

Bhuiyan, N., and A. Baghel. 2005. "An Overview of Continuous Improvement: from the Past to the Present." *Management Decision* 43(5):761-771.

Briales, J. A. 2005. *Continuous Improvement through Kaizen: Case Study of DaimlerChrysler Brazil*. M.Sc. thesis – Federal University Fluminense, Niteroi, RJ, Brazil. (in Portuguese)

Correa, H. L., and I. G. N. Gianesi. 1993. *Just In Time, MRP II and OPT: a Strategic Approach*. 2. ed. Sao Paulo: ATLAS. (in Portuguese)

Corrêa Netto, O. J., and G. E. Vieira. 2008. "Kaizen 3P – Preparation of Production Process: Continuous Improvement Case Study on Cosmetics." *Proceedings of the XV SIMPEP*. (in Portuguese)

Diehl, A. A., and D. C. Tahtim. 2004. *Research in Applied Social Sciences: Methods and Techniques*. Sao Paulo: Pearson Brazil. (in Portuguese)

Fukui, Y., and T. Ushijima. 2007. “Corporate Diversification, Performance, and Restructuring in the Largest Japanese Manufacturers.” *Journal of the Japanese and International Economies* 21(3):303-323.

Ghinato, P. 2000. *Production and Competitiveness: Applications and Innovations*. Editors Adiel T. de Almeida & MC Fernando Souza. Recife: UFPE (in Portuguese)

Liker, J. K. 2005. The Toyota Way: 14 Management Principles of the World's Largest Manufacturer. Porto Alegre: Bookman. (in Portuguese)

Martins, P. G., and F. P. Laugeni. 2005. *Production Management*. Sao Paulo: Saraiva. (in Portuguese)

Meade, P. T., and L. Rabelo. 2004. “The Technology Adoption Life Cycle Attractor: Understanding the Dynamics of High-tech Markets.” *Technological Forecasting and Social Change* 71(7):667-684.

Moraes, R. F., C. E. S. Silva, and J. B. Turrioni. 2003. “Kaizen Philosophy Applied in an Automotive Industry.” *Proceedings of the XXIII ENEGEP*. (in Portuguese)

Ohno, T. 1997. The Toyota Production System: Beyond Large-scale Production. Porto Alegre: Bookman. (in Portuguese)

Osada, T. 2002. Housekeeping, 5S: Five Key Points for the Total Quality Environment. Sao Paulo: IMAM. (in Portuguese)

Prado, C. S. 2006. *Proposal of a Lean Production Development Model with the Use of Visioneering Tool*. M.Sc. thesis (Mechanical Engineering) – School of Engineering at Sao Carlos, University of Sao Paulo, Sao Carlos, SP, Brazil. (in Portuguese)

Santos, J., R. Wysk, and J. Torres. 2009. *Optimizing Production with Lean Methodology*. Sao Paulo: Hemus. (in Portuguese)

Sharma, A., and P. E. Moody. 2001. *The Perfect Engine: How to Win in the New Demand Economy by Building to Order with Fewer Resources*. New York: Simon & Schuster.

Shingo, S. 1996a. *The Toyota Production System*. Porto Alegre: Bookman Publisher. (in Portuguese)

Shingo. S. 1996b. *Production Systems with Zero Stock: The Shingo System for Continuous Improvement*. Porto Alegre: Bookman Publisher. (in Portuguese)

Tripp, D. 2005. “Action Research: a Methodological Introduction.” *Education and Research* 31(3):443-466.

Turrioni, J. B., and C. H. Pereira Neto. 2012. “Chapter 7, Action Research in Industrial Engineering.” In Miguel, P. A. C. (coord.). Research Methodology in Industrial Engineering and Operations Management. 2 ed. Rio de Janeiro: Elsevier, ABEPRO. (in Portuguese)

Womack, J. P., and D. T. Jones. 2004. *A Lean Thinking in Business*. 7 ed. Rio de Janeiro, Campus. (in Portuguese)

Womack, J. P., and D. T. Jones. 1996. Lean Thinking: Banish Waste and Create Wealth in Your Corporation. New York: Simon & Schuster.

Yin, R. K. 2015. *Case Study: Design and Methods*. Porto Alegre: Bookman. (in Portuguese)

Zuber-Skerritt, O., and C. Perry. 2002. "Action Research within Organizations and University Thesis Writing." The Learning Organization 9(4):171-179.