# The importance of visual working instructions in standardization

**Maria Cabral Couto**

Industrial Engineering and Management

Instituto Superior Técnico, Universidade de Lisboa, Portugal

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**Abstract**

Given the growing business competitiveness, quality and efficiency became key drivers to assure a company's success, within the current industrial context. Lean methodology has been used widely across industries and is focused on increasing efficiency, by eliminating waste and focusing on value-added activities. Standardization has also proved to be essential when improving organization and increasing productivity within companies.

ABC company has been facing inefficiencies on the shop floor, associated with significant variability in the duration of its' activities and on the products' quality, and presents a low standardization level. Therefore, the company has requested the intervention of Lean professionals to develop a viable solution.

The solutions developed rely on a bibliographic review, allowing for framing with existent approaches. Afterward, a diagnosis of the initial situation is made, based on the employees' perceptions and the methodology defined. This is followed by the presentation of concrete and well-founded solutions, according to ABC's main goal – to increase the level of standardization in the company, based on the Lean methodology, through the development of working instructions. Additionally, the impact of other possible solutions, with a greater degree of digitalization, is studied.

The implementation of the solutions will bring benefits in terms of improving process efficiency, cost reduction, and compliance with sustainable metrics.

**Key-words:** Lean, SOP, Working Instruction, Standardization, Continuous Improvement

## 1. Introduction

Nowadays, customers require shorter lead times, customized products, and greater variety. Lean methodologies and standardization have been key concepts when aiming to increase productivity, improve flows and minimize waste.

ABC is a leading company in the national market in its area. ABC can either sell or rent its products and, in the second case, the recovery of the components represents an essential activity.

Lately, the company has been feeling great variability and lack of defined

procedures in its operations, which have been limiting its production capacity. The company aims to increase its efficiency, in terms of costs and sustainability, and standardize its operations. In its area, factors such as the response time, the flow of operations, and the recovery of materials are key drivers.

The implementation of Lean methodologies and the standardization of the operations were presented to ABC as potential solutions.

Initially, a bibliographic review, focused on Lean methodologies and standardization was handled. Second, it is presented a general framework of ABC, its operations, and processes. Then, the challenge is addressed. The methodology developed allowed to build a diagnosis to assess the problems felt. Minding the findings, well-structured solutions were proposed to the company on three axes: standardization, maintenance, and organization. The impacts were estimated, and the solutions are expected to impact positively the company. Ultimately, the main conclusions of each chapter and the future work are presented.

## 2. Bibliographic Review

### 2.1. Lean

The concept of Lean has its roots in America, back in the 20th century, when Henry Ford built a continuous assembly line, to increase the production volume and decrease the assembly time of the "Model T". Three decades later, the Toyota Production System introduced a similar system, to maximize the economic efficiency, [1-2]. Lean intends to maximize efficiency, while minimizing waste, time, and costs, [4,7]. One pillar of Lean implementation is continuous improvement, [7].

To assure a structured implementation of Lean, five Lean principles were defined, [4]:

1. Specify value, through the customers' eyes;
2. Identify the Value Stream Map;
3. Create a smooth flow of activities;
4. Implement Pull Production;
5. Pursue Perfection.

These principles are essential tools when identifying value-added activities and the seven types of wastes (Muda): Defects, Transportation, Over-Processing, Motion, Over-Production, Inventory, and Waiting, [7].

Lean relies on several methods to assure a goal-oriented implementation. This case study is focused on two of them:

**5S -** is a systematic Japanese methodology, easily adapted to different industries, which aims to organize the workspace and eliminate non-value-added activities, leading to more productive environments, [3]. Each S stands for a Japanese word, later translated to English: Seiri (Sort), Seiton (Straighten), Seiso (Shine), Seiketsu (Standardize), Shitsuke (Sustain), [3, 8].

Recently, a sixth S was added – Safety – and led to a significant decrease on the rate of injuries, by improving health and safety measures within a company. It is referred to as Lean "6S" or "5S + Safey", [13].

**Value Stream Map** – this tool allows to map all the activities related to a product, including information and materials' flows. From a macro perspective, it is possible to focus on and improve value-added activities and eliminate waste. Applying this process iteratively leads to more efficient flows, [12].

## 2.2. Standard Work

Standardization is one of the Lean components and refers to established procedures, that describe the best method to complete a repetitive activity. It contributes to decreasing human errors and the variability of the processes and improves the activities and flows, [5-6].

One tool used in the realm of standard work is Working Instructions (WI), which intend to guide the work and explain to the operators the procedures to follow.

Several advantages are associated with the use of WI in companies, [9-10]:

- Reduces the time required for training;
- Decreases the number of errors and job accidents;
- Increases productivity and quality;
- Increases the engagement of the operator with the task, increasing his level of satisfaction;
- Contributes to standardizing the procedures and the quality to achieve.

WIs can fit different purposes, from describing the activities to follow to complete a procedure, to defining quality standards, [10]. WIs can present different levels of information, according to its complexity, as presented in figure 1.

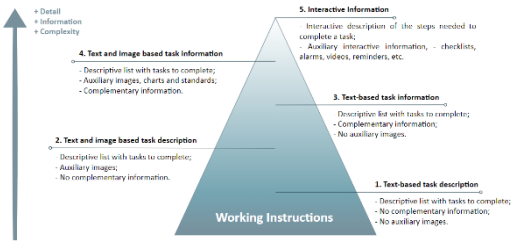


Figure 1: Levels of information and detail on Working Instructions

Along this work, the focus regards the fourth level of the pyramid – designated by some authors as Standard Operating Procedure (SOP), which regards a specific case of WIs.

Aiming to uniformize its work, the number of companies implementing SOPs has been increasing, [11]. SOP regards a written document with detailed instructions, to help workers to perform tasks more autonomously and comply with the quality standards. It should identify who, when, what, and how, [10]. SOPs should be accompanied by images to ease understanding, use clear language and contain updated information.

WIs can also fit another purpose – standardize the quality to achieve in a given procedure. These are quality standards WIs and intend to describe the characteristics a component should achieve to comply with the quality standards, [14].

Currently, paper-based WIs are the most common in companies. However, the fast-changing environments faced by companies require employees who can adapt and learn in a rhythm that follows, [9]. Digitalization allows building interactive and animated WI, providing tools that contribute to faster learning. To assess the advantages of digitalization, a case study comparing the performance of operators based on paper-based and digital WI was analyzed. The results indicate that digital WI presents significant advantages: reduced number of errors, decreased production time, easiness to update the instructions, greater adaptability and the possibility to connect with other systems of the company, (e.g. to measure KPIs), [9]. Nonetheless, digital WI requires greater investment and eventually, training. The expected course of evolution is that companies will tend to gradually abandon paper-based WI and embrace the digital ones, [9].

## 3. Problem Description and Diagnosis

### 3.1. Company and flows

ABC company provides a set of products that can fit different purposes and is focused on selling/ renting its products. The product is formed by different types of panels, assembling components, and other components, which are part of the interior (e.g. furniture).

ABC is responsible for assembling and delivering the final product. When the renting period ends, the product is returned and recovered on the installations, following the flow presented in figure 2.

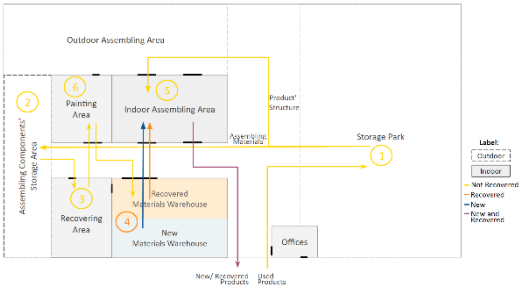


Figure 2: Materials' flows

The recovery is centralized in two main areas: the Recovery Area and the Assembling Area, and is divided into three phases: the triage of the components, the recovery activities itself, and the verification of the final quality.

After recovering the components, the operators register the component and quantity on an appropriate sheet, except for the panels, which are not registered nor monitored.

### 3.2. Challenge

ABC identified obstacles and improvement points to its operations. The obstacles are felt across the whole organization – from the management to the operational team. The study object was suggested by ABC and focused on the recovery of materials, as it was considered a critical phasis, due to the great impact on costs and metrics to achieve. One major problem regarded the great variability of the processes and durations of the recovery activities – ABC lacks standard and documented procedures and, consequently, the activities are performed according to different principles. Another issue concerned the lack of monitoring of the panels recovered on the shop floor, as those are one of the materials with greater impact on costs.

The challenge concerned uniforming and improving the efficiency of the operations and accounting for the recovery of panels.

### 3.3 Methodology

The methodology to develop the diagnosis was based on three main work envelopes:

1. Several meetings with team members from different hierarchical positions, from the management to the operational team. The objective regarded comprehending the differences between the theoretical and the real flows, understanding the difficulties faced by each team, and defining the priority problems to solve.

2. Analysis of documents, to know the rotativity and consumption of materials, sales, and purchases. It permitted sorting the components by the impact on costs and evaluating which ones are worth recovering.

3. Visits to the shop floor, that allowed to observe the activities being performed, perceive the flows and obstacles, list the materials and tools used, and identify value-added activities and wastes.

### 3.4 Diagnosis

To evaluate the current situation in ABC, the methodology was used to build a diagnosis, which allowed to quantify the dimension of each problem.

Regarding the lack of defined procedures for the recovery activities, ABC works with 370 components but only has a recovery process defined for 221 of those (around 60%), and only six components have a documented, standardized process, as represented in figure 3. Overall, only 16,8% of the components used is recovered, being the remaining totally discarded.

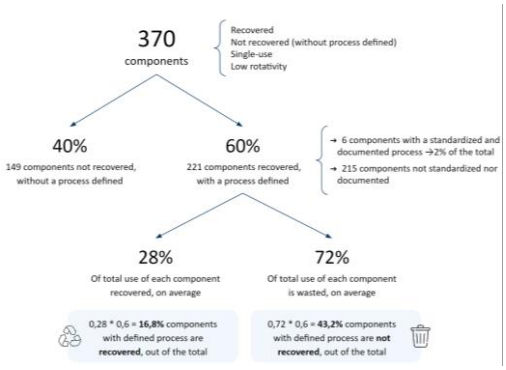


Figure 3: Schematic representation of the recovery percentage of the components

For the 221 components, with a defined process, but not documented, the responsible operator has defined a process that allows the recovery, however, the non-dissemination of knowledge results in the operators not being aware of the process, and following different procedures, according to their experience. The triage criteria for the same component also varied, depending on the operator. The variability felt is expressed in table 1.

The lack of defined procedures and the variability expose the low standardization level in the company.

Table 1: Variability felt on Gemba

| Variability | | |
|---|---|---|
| **Duration** | **Process** | **Triage** |
| **17%** Of the activities performed by inexperienced workers were, on average, 17% longer. | **65%** Of the recovery process for the same component followed different procedures. | **12%** Of the components followed different criteria for the triage. |

When assessing the lack of control for the panels' recovery, it was concluded that the panels account for over 50% of the total cost of the product. The components were sorted by the impact on costs, considering the rotativity and unit cost of the previous year. The panels represent around 40% of the total costs of ABC with components and materials, expressing the urgency on monitoring the related activities.

Moreover, the panels are recovered in two areas: the recovery area – where they are recovered in advance, stored until needed, and, finally, assembled on the product; and the assembly area – the panels are recovered, already assembled, in a pull system, after there's an order from a client. The company does not have information on which one is more beneficial.

ABC also faces problems concerning its organization – different materials mixed in the wrong location and locations without or with outdated labels lead to an increasing entropy and more errors by the operators. Although these problems were not the core of the project, they were also addressed.

After assessing the main issues, it is of great importance to identify the root

causes, to assure that the solutions target the causes of the problems. It was noticed that the company was not aware of the impact of the operators' actions on its' results. The low standardization level, poor communication top-to-bottom and lack of time from the management to address operational matters were considered root-causes.

### 4. Solutions

Minding the findings from the diagnosis, it became evident the importance of standardization for ABC. Therefore, the solutions were developed in three axes: standardization of the recovery processes through the development of Working Instructions, update the maintenance sheet to allow accounting for the panels, and increase the organization level.

### 4.1. Working Instructions and Analysis

Defined processes were claimed to be essential to promote independence, to guarantee uniform processes, and to assure compliance with the quality criteria. To comply with those requirements, it was decided to develop WIs for each component, describing all the activities needed to be performed to recover each component and the quality standards to achieve. So, each WI for each component would be formed by three documents, presented in figure 4.

**1. Triage Quality Standard:** a document to guide the triage process, describing the requirements the component should meet to be able to be recovered.

**2. Standard Operating Procedure:** details the activities to perform for the recovery and the materials and tools to be used.

**3. Final Quality Standard:** states the quality the product should achieve, after the recovery process.

The template was decided with the ABC team. The documents should be displayed on the shop floor and be easily consulted. The consultation method adopted by the company was paper-based – the WIs were printed, instead of digital-based, as it required greater investment, and the company did not have the necessary equipment for consulting on spot.

The WIs were developed using Soft4Lean, a specific software for the purpose, which enabled a higher level of digitalization to the solution. The software allowed adding text and photos on spot – during the observations, and highlighting the information, without facing any formatting issues, as it happens in more analogical tools, such as Excel. Comparing using both tools, it was concluded that the time required to complete a WI using Soft4Lean instead of Excel was 18% smaller. However, the use of Soft4Lean requires a license for each device where it will be installed, representing an extra cost for the company.

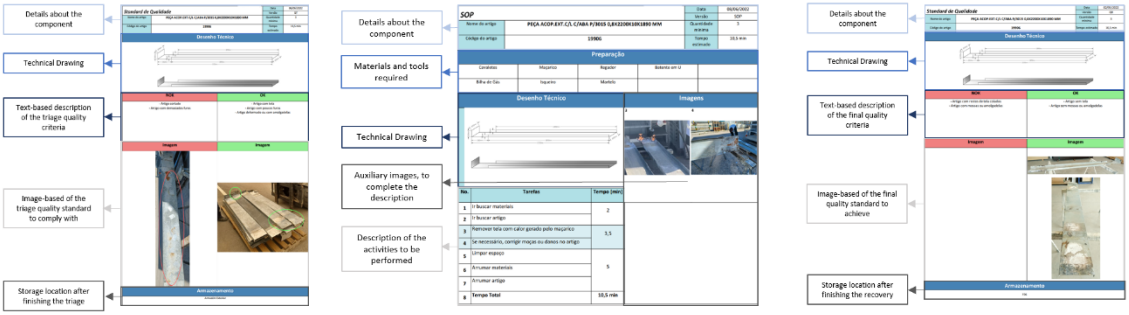


Figure 4: Example of WI - Triage Quality Standard (left), Standard Operating Procedure (center), Final Quality Standard (right)

The development of the WIs required observing each recovery process, at least 3 times, to decrease the variability in the process and duration, and to gather information on the materials and tools needed and on the quality criteria.

The ABC team has expressed the will to standardize the process for 35 components, including panels. For that, two analyses had to be performed: an ABC and a cost-benefit analysis, whose output was the 35 most impactful components. The components were initially sorted by total impact on costs (considering the unitary cost and rotativity) – ABC analysis, and, afterward, it was analyzed if each of the first 35 components was worth recovering. This second analysis not only compared buying to recovering in terms of costs (associated with the labor, materials consumption, and overhead costs, in the case of recovering, and with the unit cost, when buying), but also considered a sustainability factor.

Four out of the initial 35 components were not worth recovering, so, those were ignored and the next four that were worth it on the list were considered. It matters to highlight that the WIs were not developed for the first 35 components of the list, but for the first 35 out of the ones possible to observe the recovery, given that some components were not available at the installations.

### 4.2. Maintenance Sheet

Currently, when a customer places an order, the activities to be performed on the panels are decided and registered on the maintenance sheet, by the responsible operator, to then be followed by the team. However, this register does not include the type nor the number of panels. To enable the accounting, the maintenance sheet was updated, as presented in figure 5.

Obsolete and repeated tasks were eliminated, releasing space to add a field to register the type of panels and the respective quantity recovered. Daily, the maintenance sheet would be delivered to the administrative team, so that team would be able to measure the impact of the recovery on the KPIs of the company.

The red boxes on the first picture identify the activities removed, and the green boxes on the second picture highlight the tasks added/ updated. On the right side of that picture, it is listed the most common panels, so the operators can indicate the respective quantity recovered of each and there is an empty space for other less common operations to be manually added and described as well.

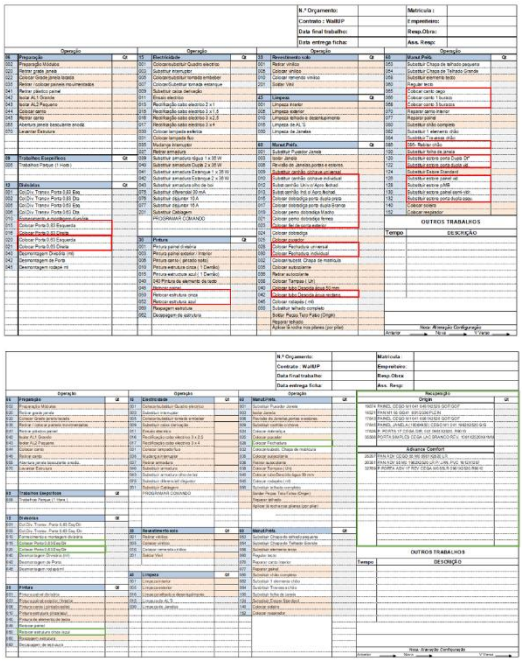

Figure 5: Maintenance Sheet improvements

### 4.3. Organization

To face the low organization level felt in ABC, the company was suggested to update all the labels to the correct respective component and to assure that all the locations were clearly identified. The template for the label should be equal and contain the same information for all the locations. Moreover, ABC was

recommended to distinguish the locations with different colors, according to the state of the materials – depending if it is new, recovered, or to be recovered, facilitating the search and storage process for the operators. Moreover, it was suggested to create awareness among the operators on the importance of a clean space and the impact of their actions on the company's results.

### 4.4. Impact

The areas of impact of standardization are expected to be extensive, and its qualitative and quantitative impacts will be assessed.

WIs are expected to lead to an increase in the final quality of the products, assuring the quality level desired by the customer, and improving the safety and autonomy of the operators. Furthermore, it is expected to bring flexibility and response capacity to the company and disseminate technical knowledge among the workers. Having visual instructions helps surpass the language barrier and makes the WIs more inclusive and accessible.

From a management point of view, WIs allow estimating the duration of the activities, and the productivity of the operators, and monitoring the consumption of materials, permitting a more assertive control of the activities and of the costs associated.

The short duration of the project did not allow to implement of this solution in ABC. Regardless, the impacts were estimated, and the templates and documents were presented to the management and operational team, which approved the WIs and expressed satisfaction with the final result. The operational team claimed that the images were essential and the instructions were clear.

The variability in the process duration is expected to decrease by 13%, by eliminating non-value-added activities and standardizing the processes, as presented in figure 6. With the implementation of the quality standards, stating the initial conditions to meet, the triage process is expected to decrease by 10% and the duration of the recovery process is expected to stabilize, as the process will become more uniformized. The description of the activities to follow, accompanied by images, is expected to lead to a reduction of 15% in the duration. The storage phase' duration should not suffer significant differences.

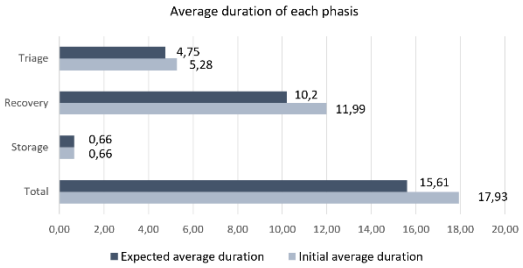


Figure 6: Comparison between initial and expected average duration for each recovery' phasis

Moreover, initially, the company presented an average recovery rate of 28%. By increasing it to 75%, considering the 35 chosen components, the company will be able to save 211 845€ per year, which corresponds to a 56% reduction on costs. This value was achieved by the difference between the buying cost and the recovering cost, which already considers the extra costs – labor, materials consumption and overhead costs.

In contrast, the maintenance sheet was implemented in the company. As ABC stated, "it was an essential step to improve the results of the company, increase the recovery rate, and allowed to understand the huge savings this activity promotes". The implementation allowed to account for the panels recovered, in terms of costs and sustainability metrics, and better manage the work happening on the shop floor. The

company shared the solution with other locations and implemented it there as well, given the positive results. The feedback from the operators was equally positive, as they considered the solution easy to use and stated that it would only consume a few extra seconds, compared to filling the initial maintenance sheet.

The increased organization of the shop floor led to fewer storing errors, less time spent searching for components, and a cleaner and visually more appealing space.

**5. Conclusions**

Both regarding the creation of WIs and the implementation of the maintenance sheet, the impacts observed derive from two strands. The development of standard processes, easier to access to any worker, allows to accelerate the recovery process of the components, and the development of new WIs, for components that previously were discarded, permits to increase the recovery rate of ABC. Regarding the panels, the implementation of the maintenance sheet allowed an expressive improvement in the accounting of the panels and in complying with the sustainability metrics, besides providing closer control over the operations on Gemba. Both solutions contributed to increasing the standardization level of the company. These impacts, as a result of standardization, are aligned with the objective of the Lean methodology

The implementation of the WIs is expected to decrease the duration of the processes by 13%, on average, and allow to save 211 845€, for a recovery rate of 75%, for each of the 35 components. The impact would be even more expressive if the analysis was done to the first 35 components of the list, and was not limited to the availability of the observations. Moreover, there is a huge potential for cost savings by expanding the standardization to the remaining components, given that the 35 components selected only represent 9% of the components used, in terms of quantity.

The impacts are expected to be maximized after the implementation of the WI, as those are expected to accelerate the activities and define the quality levels to comply with. The feedback and operators' involvement were essential to develop accurate solutions.

Regarding the two areas where the panels are recovered, it was concluded that in the recovery area the quality tends to be higher and it allows to better deal with the high season. In contrast, in the assembly area it consumes less time and allows a faster production rhythm. The company should evaluate this trade-off and choose according to its preferences.

The increase of the efficiency of the processes in ABC is also associated with a cleaner and more organized workspace, which leads to fewer errors, is more intuitive/ visual for the operators and reduces the time needed when looking for a certain component.

For future work, the company is recommended to implement the WIs built and develop more for the remaining components. It was also suggested the creation of a continuous improvement department, to continue the work initiated, and the promotion of clarification sessions with the operators, to explain the importance of the solutions and of their work on the company' results. Finally, the company was advised to explore the potential of digital solutions.

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