

ASSESSMENT OF INTERNAL LOGISTICS IMPROVEMENT OPPORTUNITIES: THE CASE OF A SANITARY METALS COMPANY

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Abstract

To keep up with the global competitiveness, companies have been investing more each day in implementation of tools belonging to the philosophy of Lean Production (LP) throughout the production chain. The logistics sector has been one of the improvement focuses, as it features one of the largest costs related to manufacturing. The implementation of LP tools in internal logistics has proved an efficient alternative in reducing logistics costs and enhancing material flow. This work aims to identify and evaluate existing problems in the internal logistics flow in a company in order to elaborate an improvement proposal based on the Lean philosophy. This methodology consolidates information through additional methods for qualitative analysis to assess problems from different views, brought by each method. The application of the method will be illustrated in a company of hydraulic tools and decorative sanitary metals, which is currently implementing LP tools. Among the results, it were highlighted an improvement in the production flow, obtained by reducing the number of operators in the internal logistics and decreasing 85% of the errors related to the shipment of finished products.

Keywords: Lean Production, Mizusumashi, Internal Logistics.

1. Introduction

The sanitary metal sector is inserted in the civil construction segment, and handles about 600 million dollars a year according to Siamfesp's estimates (Union of Nonferrous Metal Artifact Industries), which brings together companies in the sector. Silveira (SILVEIRA, 2006) attributes the sanitary metal production a customer service difficulty due to delays in delivery time, large lead times and high costs. Over the past decade, companies of this segment have worked to transform its traditional manufacture model base to model that is more productive and have more flexibility with higher added value. In this sense, it seeks to reduce waste in production system, increasing demands for quality and flexibility in all organizations aspects, including the internal logistics, for example (COIMBRA, 2013).

The internal materials logistics present key roles for better production system performance (LEITE; 2013). Thus, the occurrence of faults in internal logistics such as lack of material in the production line, the material excess and unnecessary waiting operator availability; can compromise the internal flow of the factory, damaging their productivity and committing deliveries to customers (DIAS; 2012). Therefore, this article aims to identify the main internal logistics problems and its wastes, in order to compare them with those observed in practice in a company that is already in a lean implementation process.

2. Literature Review

The internal logistics comprises the stream of materials within the production area, also including the flow of information regarding the communication between productive sectors (COIMBRA; 2013). It covers from the receipt of raw materials to the shipping of finished

products, and is responsible for efficient handling and storage throughout this journey (ROTHER; HARRIS, 2001). In the context of lean production, due to its focus on waste-reduction, internal logistics plays a key role in supporting the just- in-time strategy (JIT), which means producing the required items in the necessary time and quantity (DENNIS, 2008; DOMINGO, 2007). However, proper implementation of lean practices aimed at internal logistics is still a theme that portrays difficulties. Besides the influence of contextual factors relevant to each company (MARODIN *et al.*, 2012) making it difficult to directly apply these practices, there are further questions involving the incidence level of logistical companies' problems.

According to Leite (2013), within logistics there are many different factors that can adversely affect plant productivity. Table 1 consolidates the main problems cited in literature focused on internal logistics and its corresponding authors. The "Excess materials in line" problem has a higher citation frequency in the investigated literature. Dias (2012) comments that the excess of material on production lines is as damaging as the lack of those, since both situations lead to a break in production flow. It also highlights the "lack of pattern" problem. Torres (2012) states that the lack of standardization in material transportation can generate an unbalance amount of material transported at a time, creating disturbances in production flow. In addition to the issues related to material handling, the "Moving line operators" problem also prejudices the production flow. This is due to the fact that the production operator is the one that adds value to the product, and its unnecessary movement interrupts the process (COIMBRA; 2013).

For the JIT operation in internal logistics there is a logistics operator responsible for the material flow. The logistics operator, or *mizusumashi*, is the key for creation of the internal materials flow (COIMBRA; 2013). The *mizusumashi* runs through a circuit that passes in collection sites and production lines repeatedly with standardized routes and schedules (MENDES, 2010). There are 6 main steps for the implementation of *mizusumashi*, as described in Figure 1.

Authors	FELD, 2011	COIMBRA, 2013	DOMINGO, 2007	FREIRE, 2008	NEVES, 2009	MENDES, 2010	SILVA, 2008	DIAS, 2012	MARODIN <i>et al.</i> , 2012	TORRES, 2012	SAHIN; SATOGLU, 2013	JADHAV <i>et al.</i> , 2014	LEITE, 2013	PEREIRA, 2014
Excess of on line materials			X			X	X	X				X	X	
Lack of standards						X		X	X	X	X			
Lack of material	X					X	X	X			X			
Line operators movement	X		X			X		X						X

Excess of operators in material logistics			X	X	X
High level of internal traffic	X	X			X
Unload displacement time		X			X
Transportation damaging products			X	X	X
Wait for transporters	X				X
Fatigue along the journey		X			X
Transporters long setup time					X
Nonstandard containers			X		

Table 1 - Problems in internal logistics



Figure 1 – Stages of mizusumashi implementation
Source: Coimbra (2013)

Step 1 consists in listing all the activities carried out by the *mizusumashi* since its starting point (collection of *kanbans* or its requests) until the end of cycle, after distribution

of line materials. This information enables the execution of step 2, which draws up the rout of *mizusumashi*, deciding which stop for line supply in a way to run the smallest possible way in a standardized route (HARRIS *et al*; 2004). Then, in step 3, it creates a transporter prototype in actual size. In step 4, the proposed process along with prototype developed on plant's floor is tested.

Before the standardization process, it is necessary to eliminate all wastes found on test made on plants floor, which is attributed on step 5. Thus, on step 6, the *mizusumashi*'s Standard Work Sheet is created, that corresponds to the final process (ROCHA; 2012), as shown in Figure 2

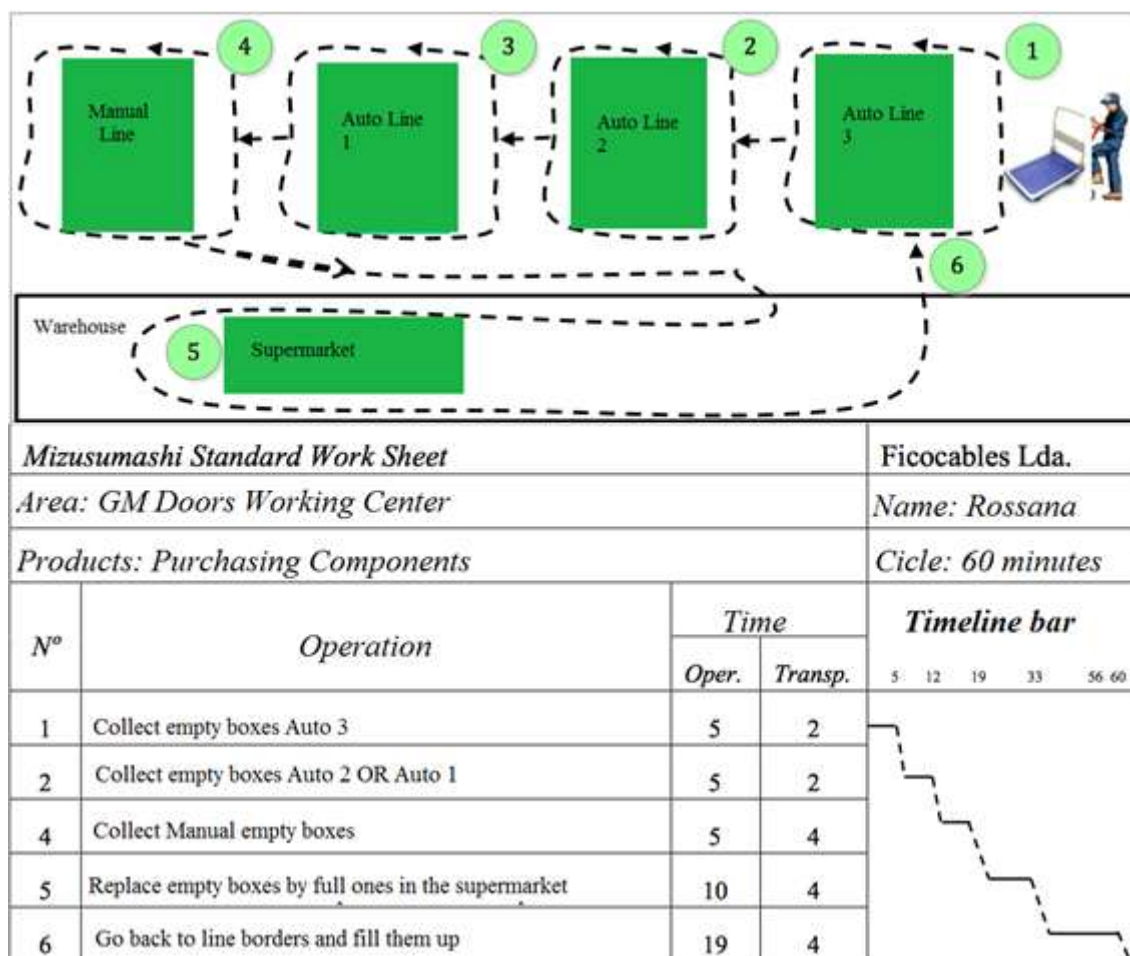


Figure 2 – Exemple of Standard Work Sheet

3. Proposed method

The used methodology was divided in steps for the case study execution. Figure 3 briefly illustrates the 6 steps elaborated for this project.

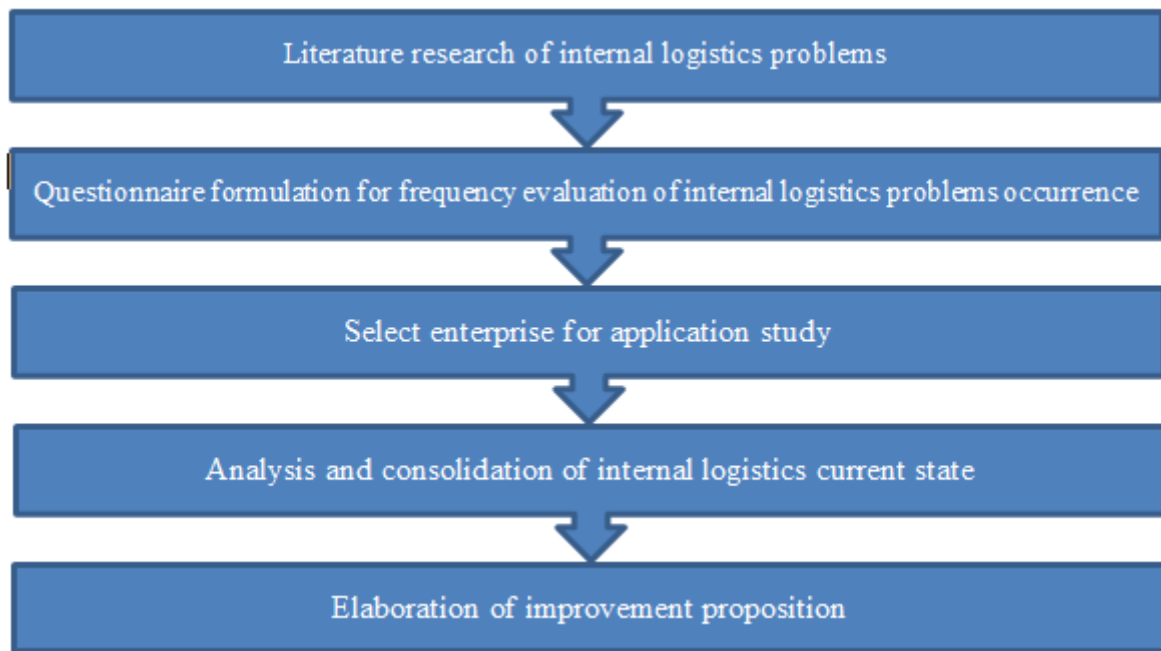


Figure 3 – Project methodology

Based on literature research about the internal logistics theme, which presents its main problems consolidated on Table 1, it was developed a questionnaire in order to verify the frequency of these problems occurrence frequency based on the company being studied. The questionnaire has 12 questions, and each one of them is directed to already quoted problems, as shown in Table 2. Each question was evaluated using a scale from 1 to 5, where 1 designates a situation that never occurs and 5 a situation that always occur.

After choosing company, the analysis and consolidation of current state of its process turned to internal logistics starts. The analysis will be done based on three ways: (i) application of proposed questionnaire, (ii) gemba walks (go to location where process occurs) and (iii) interview with employees who work directly on plant's floor. The gemba walks were performed daily on selected sector, it is recommended at least one hour a day observation.

Questionnaire about internal logistics problems					
Questions	Frequency of occurrence				
	1	2	3	4	5
P1. Occurrence of transporters traffic					
P2. Frequency of damaged products due to sloppy transport					
P3. Unnecessary movement of line operators					
P4. Lack of material in line					
P5. Excess of materials on line					
P6. Waiting for forklift or transporter					

- P7. Logistics operator fatigue throughout the working day
P8. Long setup of forklifts or transporters
P9. Too many operators in internal logistics
P10. Displacement routes without loads on transporters or forklifts
P11. Transportation difficulties due to nonstandard containers
P12. Difficulty by lack of standard in internal logistics

Table 1 - Questionnaire

*Subtitle:	1	Never
	2	Almost Never
	3	Sometimes
	4	Almost Always
	5	Always

The purpose of the interviews is to identify wastes on process operation, which actually occurs daily and in what situations we find the operators involved directly with it. Table 3 shows the basic script used in the interviews. The analysis of the current state is, therefore, the set of information reunited on the three methods described.

1. What is your function?
2. Describe your function and power.
3. Describe the logistic process assigned to this function.
4. How is it done in practice? Step by step.
5. What are the difficulties in carrying out this process (show them where possible)?
6. What are your suggestions for process improvement?

Table 2 – Script for interviews

4. Results

The company studied operates on sanitary metal sector and currently counts with about 1600 employees, being characterized as a large one. It includes the production of various products, including faucets, records, showers and flush valves.

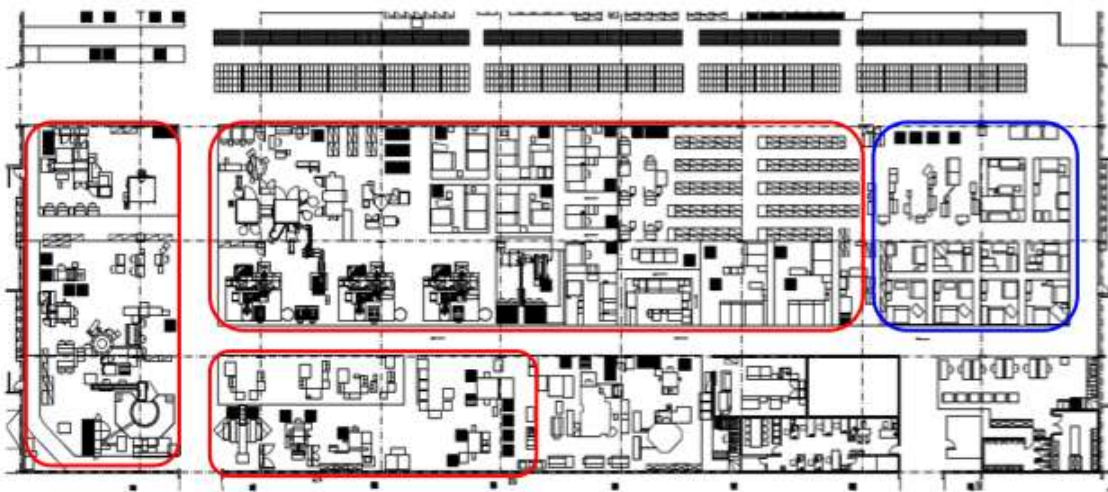
It produces about 90 % of all components used in the final assembly of products, has 4 production plants and a distribution center with over 1,200 end products. Products are mostly chromed, resulting in disposal or rework in case of damage in transport. In addition, some product families have electronic components such as in automatic faucets, for example, requiring special care by logistics for being pieces of high value and easily damaging.

The company finds itself in a highly advanced stage on PE implementation, but the cited practices are not implemented throughout all production, with some lines still working entirely in traditional production molds. On assembly sector it circulates about 23,000 components. The layout and operation of production lines show two formats: there are lines in

traditional format, operating with aid enhancer's line; and there are lines with cellular layout, which shows some practical PE.

The *mizusumashi* is responsible for supplying the line side in 8 production cells, a small area of the assembly plant. Each line has a facilitator, which beside the previous mentioned functions, are responsible for pointing out the company's system all the products produced and take them to the shipping area. The *mizusumashis* (of supplies and collection of finished products) also fulfill other functions in logistics, because this task does not occupy the whole time of working hours, both operate on routes every 40 minutes.

In Figure 4 the areas supplied by each type of process are highlighted, being the areas in red production lines in traditional format supplied by line facilitators and the areas in blue production cells supplied by *mizusumashi*. Facilitators have no set routes or schedules and can often disrupt the flow of *mizusumashis*, by running in the same transit corridors.



Lines in blue: work with *mizusumashi* (cells)

Lines in red: work with line facilitators

Figure 1 - Mounting area of the plant and its suppliers

From the gemba walk, which was the first analyzed method, three major issues were identified. First, there is the problem of "errors of finished products appointment". This was done by all line facilitators and all *mizusumashis*, and due to a lack of process standard errors in the system related to quantity, or product type were made. This process is quite simple, but its flaws can pass on to final customer due to the sending of products or incorrect quantities.

After, it was found a second problem called "excess of operators", which entailed the idleness of *mizusumashis*. Finally, the problem of "unnecessary movement of line operators" was identified once the line facilitators frequently found themselves outside their posts solving problems. From the observations, it is estimated that on line facilitators are found outside their posts 25% of the total time of their shift.

Regarding the interviews, 12 line facilitators and 4 operators who performed the *mizusumashi*'s functions were asked. The most mentioned problems were those directly associated with their daily functions. Between those, four stands out: (i) "lack of shelves", (ii) "pallet accumulation on shipping area", (iii) "lack of internal logistics standards" (iv) "transporters traffic".

The "pallet accumulation on the shipping area", also observed in gemba walks, was originated due to the fact that the line facilitators carry finished products only at the end of each production shift. Thus, the area available for these pallets storage did not show capacity for this volume. Since both *mizusumashi* and line facilitators use the same space corridors, the

“transporter’s traffic” was strongly mentioned, once the last one provided delay on routes. In addition, the “lack of standard” in pallets, reflected by its poor staking or use of several boxes, hinders the expedition process and, therefore, was highlighted.

Finally, the results obtained through the questionnaire, applied with eight experts from the tactical and strategic levels of domestic logistics company, complemented the analysis. With the results obtained, it was made a Pareto chart (see figure 5), to highlight the most mentioned problems, according to the questions and the values shown in Table 3. It was established that the problems whose average frequency between the interviewers was higher than 3 are considered the most critical problems. The problem identified as the most frequent one was P3 (Unnecessary move of line operators), also observed during gemba walks and interviews. The second most cited problem was P12 (Difficulties caused by lack of standard on internal logistics), realized both on interviews and during gemba walks by the observer.

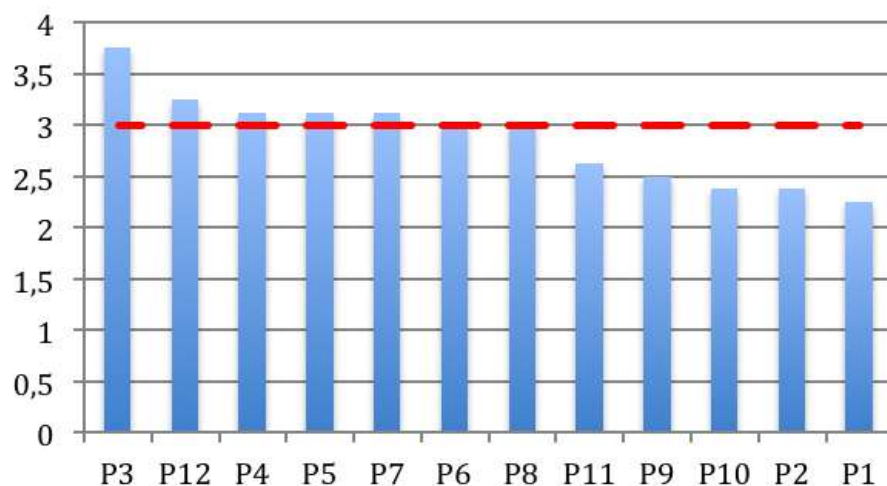


Figure 5 – Graph with questionnaire results

Through the three used methods, the main problems on internal logistics were consolidated. Table 4 does a methods triangulation, showing which the most frequent problems are and which ones were cited by each analysis method. “Lack of standard” was an issue cited on the three methods of analysis, and its occurrence interferes in most of other problems. Thus, this issue was characterized as the main point to be prioritized in improvement activities of company’s domestic logistics, regardless the strategy type of production adopted.

In order to minimize the occurrence of founded problems, the proposal’s main idea of improvement is to standardize the current internal logistics. Many of the problems cited are due to the pointing and internal transport of finished products until the expedition area, such as the exit of line facilitators to take the products, traffic of transporters, excess of materials on line, wait for the finished products to be withdrawn, lack of transporters, etc. Having that in mind, the process standardization of finished products collection can solve the cited problems.

Due to the underutilization of *mizusumashi* that collect finished products from production cells, it is proposed that it also make the product collection of all productive plant. In addition, an operator would be responsible for pointing all products in the system, taking off the facilitators of line obligations and reducing the incidence of operational errors due to process standardization.

The preparation of the standardizing process of *mizusumashi* was done according to an adaptation of the cited steps by Coimbra (COIMBRA; 2013). As the production is not leveled in non-lean lines, the frequency of products exit is highly variable, between 45 and 90

minutes per pallet. With this data we could define a *mizusumashi* route frequency in every 30 minutes, a much higher frequency than the products output made by facilitators, only twice a turn.

Problems found	Gemba walk	Interviews	Questionnaires
P1. Traffic of transporters	X	X	
P3. Unnecessary movement of operators on line	X	X	X
P4. Lack of material on line			X
P5. Excess of materials on line	X		X
P7. Logistics operator fatigue throughout the working day			X
P9. Excess of operators in internal logistics	X	X	
P12. Lack of standard on internal logistics	X	X	X
P13. Accumulation of pallets in expedition area (shift change)	X	X	
P14. Lack of shelves	X	X	
P15. Errors in the appointment of finished products	X	X	

Table 4 – problems encountered in analysis

For the set of breakpoints, the similarity of product was considered (families) and the proximity of lines. As the products output is infrequent, a method of visual management that points to the *mizusumashi* when he should enter the line to collect the products was created, the facilitator will signal the pallet that is ready to leave. This made the routes stay more agile, avoiding unnecessary stops (see Figure 6). Table 5 provides an overview of the results obtained with the improvement propose, comparing it with the current state.

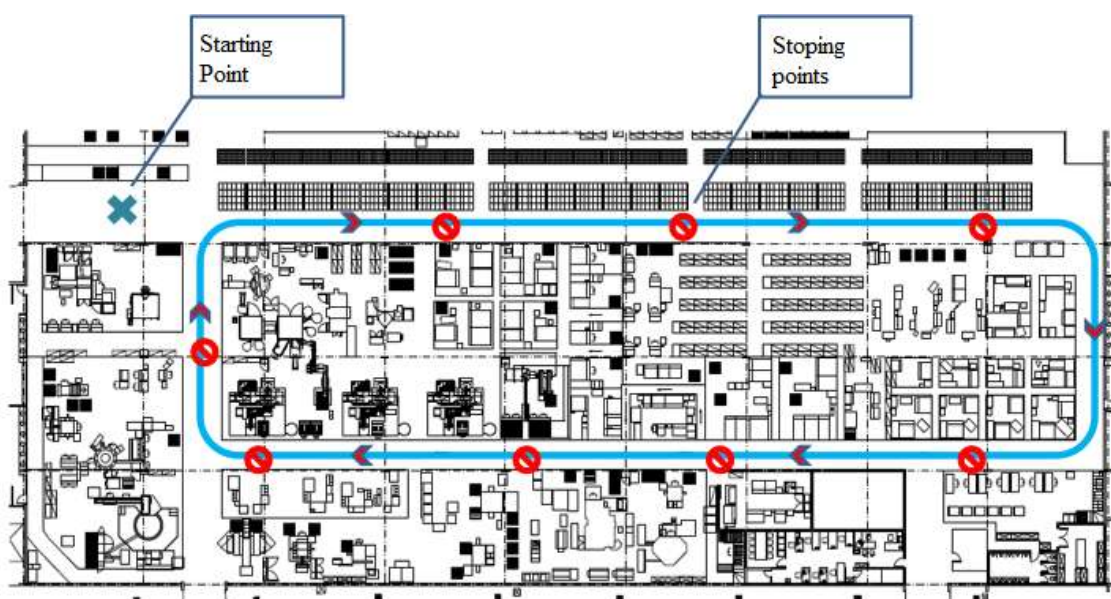


Figure 6 – New *mizusumashi*'s route

Indicators	Current State	Proposal for improvement
Stopping point	3	8
Boxes per route	25	95
N° of operators who perform transportation	13	1
N° of pointing errors per shift	15	2
N° of boxes transported by mizusumashi per day	500	2700

Table 5 – Results

As the *mizusumashi* already existed in the company, even operating in a small area of the plant, the construction of a prototype was not necessary, being only needed to test the capacity of an already existing operator. The maximum set through tests was seven full pallets. During the simulation, more wastes were eliminated. A stopping point was relocated in about 1 meter for easy access to the lines. The *mizusumashi* began to take up all its available time, solving the problem of idleness. The number of boxes carried by this operator in the proposed process went from an average of 500 boxes per day to 2700 boxes per day, using the same manpower and logistical existing train. Also, with this change, 2 of 12 line facilitators were released, because the tasks that occupied 25% of its production shift were now relocated.

As the pointing process of finished products was standardized and centralized in only one operator, the incidence of daily mistakes fell from an average of 15 to 2 errors. With the continuous flow of finished products the demanding peak for expedition declined, once that the facilitators used take the ready pallets only at the end of their shifts, causing an overload of that area.

5. Conclusion

The improvement proposal involved the logistical and production areas of the company, and there was a need to change some employee's areas. It is recommended that in future situations, the involved areas are already lined up on the beginning of the project. The feedback meetings were essential to improve the proposal, though due to various suggestions received, holding meetings with management during the preparation of the proposal is recommended for it to be prepared properly and in accordance with expectations.

In this project, it was not taken into account the ergonomic issues related to *mizusumashi* implementation. As the weight carried by that operator daily increased significantly, this is a point of attention.

In terms of the project application in other cases it is found in validation, looking for adaptations according it is applied case. Within the company, the used methodology is feasible to be applied in some areas with similar internal logistics context (pre- assembly areas and finishing part) and should be revised in more peculiar sectors (injection or casting), due to extensive machinery and type of process.

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