Lean Warehousing: Enhancing Productivity Through Lean

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Abstract. The environment dynamism of the modern era is fostering the spreading of lean in every industry. Followed by the demonstrated benefits of the lean principles in operational performances many companies have taken the leap. Nonetheless, beyond the manufacturing and mass production industries, the dissemination of lean has a long road ahead yet. Logistic and warehousing activities form part of this group, and authors agree about the limited contribution in the literature. For this reason and considering the necessity of the current era for constant optimization of the activities, increasing attention on warehousing is important. The purpose of this article is to illustrate an empirical performance of how lean is applied to the context of a logistic service provider distinguished by flexible solutions. The continuous improvement story exploits the A3 framework for building the problem solving.

Keywords: Lean · Continuous improvement · Warehousing

1 Introduction

Modern era has set complexity and competitiveness in the way to perform businesses. The dynamic environment leaded to the born and spread of what we know today as lean [1]. The set of concepts proved to provide several benefits marking the direction for testing lean principles' adaptability and expansion from the automobile industry to other industries as construction, textile, service, food, medical, etc. [2–4].

This new era has brought new challenges such as digitalization [5, 6], shorter product life cycle [7], shorter time-to-market impacting the logistics activities [8]. In order to meet customer needs, warehouses require to be constantly optimizing their activities by reducing inefficiencies and making them more reliable in terms of cost [9, 10]. Despite the spread of lean principles and the increasing attention in warehousing activities in the last years, the contributions in the literature are still limited [11]. Lean warehousing (LW), represented by the implementation of lean concepts in warehouses, is a quite new concept that must not be left behind [12].

The aim of this research is to give evidence of the creation of a leaner warehousing system through the LW, following the principles and tools of lean. The importance of this story relies on the how a leading company well consolidated can increase value with the implementation of LW approach by improving productivity. The methodology exploited is the case study. Case studies present a fundamental feature because they rely on a variety of sources of evidence that usually are not available for other

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explanatory method such as a history [13]. In fact, case studies can leverage information coming from documents, artefacts, interviews of people part of the study and direct observation of the studied events [13]. Then, the case study is the method that best fits the previously mentioned criteria and, hence the final aim of the research.

2 Case Study

2.1 Company Overview

The company MNB is one of the main logistics service providers both in Italy and worldwide. It provides services for a wide range of customers across a variety of businesses offering flexibility and suitable solutions for everyone. It is a global logistics provider which has air freight services, ocean freight services, transport execution, transport management, and contract logistics as its main services. The case of this paper is based in North of Italy, developed in one of the more than 60 establishment in Italy. The establishment serves to more than 20 customers.

2.2 Reasons for Actions

Among the main costs that MNB sustains, Handling Costs are the most significant part. We find Material & Handling Equipment cost (11%) and Labour cost (89%). As in all the warehouses of the company, the workforce is provided by the Cooperative, which has a cost-per-hour contract defined and not negotiable. In the last two years, there has been an increase of 9.5% (twice the increased in 2013–2017). This cost trend cannot be reflected upon customers, so the Business Process Excellence (BPE) team started the "Warehouse Process Improvement" initiative with the objective to improve productivity. The warehouse under analysis is dedicated to customers of the tyre industry. MNB serves two main customers in this warehouse, defined for privacy reason as Customer1 and Customer 2.

2.3 Current State

Despite the two customers are immersed in the same industry, they run business in different ways, as showed in Table 1. Furthermore, the team performed an analysis of process mapping and the estimation of incidence of the Value-Added (VA), Non-Value-Added (NVA), and Business-Value-Added (BVA) activities in the overall process (Fig. 1).

Table 1. Customer analysis

Aspect	Customer 1	Customer 2
Business strategy	Manufacturer	Distributor
Products portfolio	Passenger (88%), Truck (7%), Moto, Industry, other tyres	Passenger tyres
Level of involvement and willingness to invest	Up to date; collaborative; new and innovative techniques and tools used; high level of awareness in warehouse process; Investment oriented	Traditional and old techniques used; No interest in warehouse operations improvement
WMS sharing	Shared database and WMS; Free access to process information	No WMS; No data sharing

Fig. 1. VA / NVA analysis – customer 1 (left side) & customer 2 (right side)

The definition of the current situation highlighted the presence of problems that strongly affect productivity, which have been detailed and analysed in the root-cause phase.

2.4 Targets of the Project

Assisted by the internal analysis, the team defined the set of proper targets discussing with the company. The following targets have been fixed:

- Increase the overall warehouse productivity by 5% in terms of tons/hour moved
- Decrease performances gap between the two customers by 10%.

2.5 Root-Cause Analysis

After target definition, the root-cause analysis has been performed on each customer flow in order to identify gaps between current situation and the targets. The procedure of the root cause analysis was quite similar for the two customers' flows: the team interviewed operators involved in the processes and executed Gemba Walks. These activities have been resumed in an Ishikawa diagram, presented in Fig. 2 and Fig. 3.

In summary, despite the similarities in the process, the two systems present different issues and problems. Customer 1 flow presents a well-structure procedure; nonetheless, some opportunities can be provided. In Customer 2 flow, the lack of a defined

procedure affects significantly in the BVA and NVA activities like wrapping with plastic film and check phase for all the picking typologies, and these have a great impact on the productivity of the system.

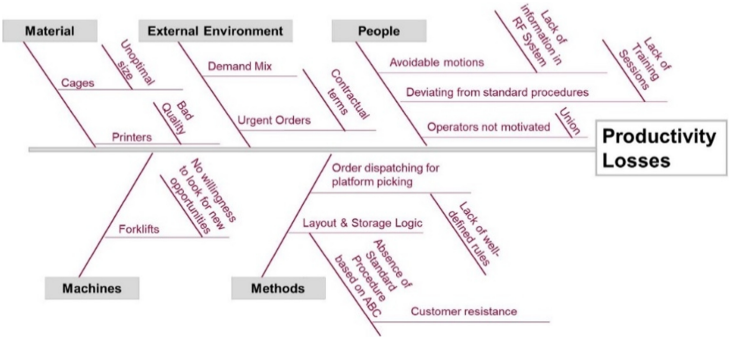

Fig. 2. Ishikawa diagram – customer 1

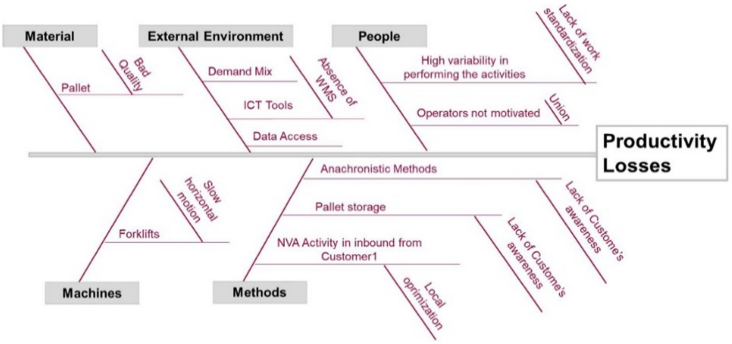

Fig. 3. Ishikawa diagram – customer 2

2.6 Countermeasure Proposals

Once the root-causes have been identified and prioritized, potential countermeasures have been proposed. Due to the high number of proposals a prioritization of the interventions resulted necessary. For this reason, the countermeasures proposed were assessed according two dimensions: the impact or benefits expected on the targets and the effort required for the interventions. In Table 2 and Table 3 the proposed countermeasures of Customer 1 and Customer 2 are presented, respectively.

Table 2. Proposed countermeasures, customer 1

Category	Description	Action area	Effort	Impact
Layout	Layout and storage allocation policy optimization based on ABC Analysis on qty picked Class A: estimate pc/SKU for Platform picking; Layout + MHE: saving area impact	Methods	3	3
Outbound	Using Conveyor to load truck	Methods	4	3
Outbound	Order the check list as the picking list so that the activity time needed can be lowered	Methods	1	1
Outbound	Planification methodology: definition of fixed rules for planning the platform picking activities (no truck). Introduce specific Call-off for each route	Methods	2	5
Inbound	Fix 2 gate for unloading and define rules to select the correct unloading area	Methods	2	1
MHE/5S	Introduction flag on the screen: show on the screen/barcode scanner if the in the next picking task, the cage is going to be emptied	People	3	3
MHE/5S	Use order picker instead of forklift for platform Picking (low pc/line): trade-off between up & down of cages and truck speed	Machines	1	2

Table 3. Proposed countermeasures, customer 2

Category	Description	Action area	Effort	Impact
Inbound	Change Inbound from Customer1 logic: Pick the needed material with order picker and prepare pallet for put away. Avoid double touch of goods	Methods	2	3
5S	Definition of Standard procedure for Loading Activity	People	1	4
Inbound	Fix 2 gate for unloading and define rules to select the correct unloading area	Methods	2	1
5S	Define the area of customer3 area with “signage” or iron protection to prevent road blocking	External Environment	1	1
5S	Definition of Standard procedure for Unloading Activity	People	1	4
5S	Definition of Standard procedure for Picking Activity	People	1	4
In/Outbound	Use cages instead of pallet. Definition of the right cage’s size	Methods	5	3
In/Outbound	Introduce a Warehouse Management System	External Environment	3	4
Outbound	Use conveyor for loading trucks	Methods	3	3
In/Outbound	Use cages instead of pallet just for picking Definition of the right cage’s size	Methods	2	3

2.7 Implementation of Countermeasures

The team estimated for each countermeasure a priority mark based on effort, costs, benefits and impact. Then, a structured implementation plan have been developed for the proposals with the highest mark values and in agreement with the company's project sponsor. Some of the countermeasures were evaluated through pilot test while others were assessed performing business cases using a simulation tool. The plan, for both customers, includes cycle time (CT) saving target, the starting data and due date for the implementation.

Focusing on the Customer 1, as shown in the Table 4, the countermeasures considered are presented with its respective % of CT saved expected. "The Flag on the screen" is a quick-win countermeasure aiming to avoid multiple motions for full-cage picking activities, with an immediately implementation and some training session to Cooperative's workers. Order planning & release required trial phase to assess the goodness of the solution and review of specific cut-offs of specific route to achieve the maximum benefits. In this sense, an ABC analysis among the different SKUs was performed to identify class A products and set new fixed positions. As regards the new layout and storage allocation strategy, a transition period for moving the cages and fix them in the new position is required, as well as other internal movements. Meanwhile, for the conveyor to load truck, a big increase on the productivity would be perceived; nonetheless. some further considerations are required based on the installation and operators' training.

Table 4. Implementation plan customer 1

Description	%CT saved	Start date	Due date
Layout and storage allocation policy optimization	7%	01/08/2019	31/07/2020
Using conveyor to load truck	37%	01/07/2019	31/07/2020
Orders planning & release	4.6%	01/07/2019	31/07/2020
Flag on the screen	0.4	01/07/2019	31/10/2019

For Customer 2, the countermeasures for implementation with the respective % of CT saved expected are shown in the Table 5. The standardization activities in the loading, unloading and picking, as well as changing the inbound from Customer1 have been implemented. A set of training sessions are required to set the pilot tests and assessments of the results. For the usage of cages for outbound and installation of automatic conveyor, the company must discuss in detail with the customer to reach an agreement leading to a long-term horizon countermeasure.

Table 5. Implementation plan customer 2

Description	%CT saved	Start date	Due date
Use cage instead of pallet for outbound (plt size)	5%	01/07/2019	31/07/2020
Using Conveyor to load truck	34%	01/07/2019	31/07/2020
WMS	18% + 12%	01/07/2019	01/07/2020
Inbound from Customer1	24%	01/07/2019	31/11/2020
Loading Standardization	19%	01/07/2019	31/11/2019
Unloading Standardization	23%	01/07/2019	31/11/2019
Picking Standardization	10%	01/07/2019	31/11/2019

2.8 Standardization and Future Steps

The company and the Cooperative approved countermeasures and set the need for definition of the new procedures as new standards. Then, for both customers, new work instructions have been written in coordination with BPE team, Cooperative shift leaders, and engineers. The new procedure allows to reduce the variability of performance providing positive effects on the warehouse productivity. The new work instructions have been attached on the warehouse walls, fully visible to be consulted at any moment. A second deliverable has been developed only for Customer 2. A feasibility assessment with productivity calculations has been developed to improve bargain power in the negotiation phase with the Customer 2.

The approved countermeasures will have high impact on company's performances, but opportunities for further improvements are still present. For the next steps, the team is already studying the implementation of a new update process that has as "zero defects". After the implementation of the new process, data would be gathered and analysed to intervene with corrective actions to solve possible issues. The steps should follow the monitoring Gantt Diagram showed in the Fig. 4.

The focus will mainly be on Customer 2 since it is the most critical one, a strong collaboration with the manager is needed to achieve common goals and reduce shared risks. A possible next goal could be increased the awareness of Customer2 manager in process improvement increasing the number of visits on site and brainstorming sessions to arise issues and develop new ideas. And for what concerns Customer1, the monitoring of the long- term countermeasure should be tackled and evaluated.

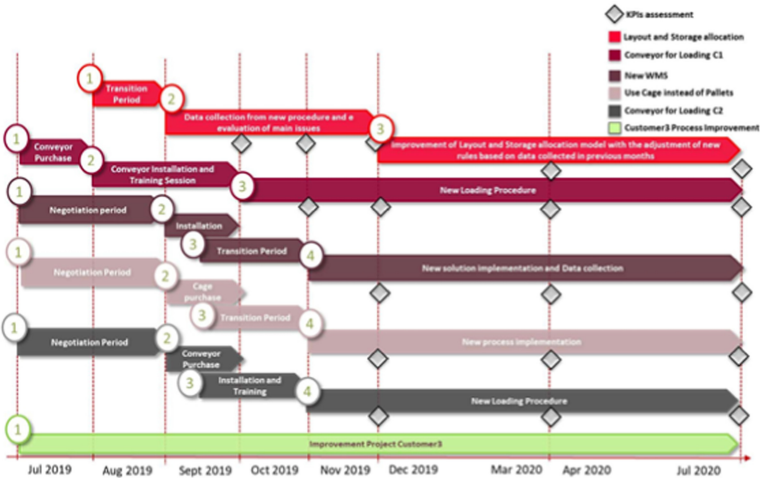

Fig. 4. Next steps – Gantt diagram

3 Conclusions

According to the best of authors knowledge, only few studies involve the implementation of lean in a logistic and warehousing context, which involves by nature in their core non-value adding activities. This article is an attempt to increase the empirical evidence of this topic, presenting a continuous improvement project that includes the application of the Lean framework in a real case study.

The company achieved significant increase in productivity through this improvement project. The findings of the project have been shared with the Top management of the company and the Cooperative shift leaders and engineers. As well the new procedures were published across the plant, and the feasibility assessment and investment for the long-term countermeasures of the warehouse of Customer 2 were delivered to the company.

Further, this paper can be helpful for managers to understand how Lean methodology can be implemented in their organisation and to incentive data-based decision making in all aspects of the business process. Finally, this case study will help the academicians and students to understand the practicality of Lean methodology adopted in logistic industry.

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