The Line Back Principle as a means of optimising logistical production processes: A case study of a household appliance manufacturer

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Abstract. This paper shows the application of a process of analysis and optimisation of logistic-productive processes based on the Line Back Principle as applied to a household appliance manufacturing company. The implementation has been based on a case study methodology, in which the researcher has led and actively participated in the implementation process. The implementation process was structured according to the four stages defined within the Line Back Principle. Through this implementation, productivity improvements, reductions in the stock, and reductions in the space occupied by the stock were obtained. The study has therefore demonstrated the validity of the Line Back Principle as a means of improving operational parameters.

Keywords: Line Back (LB), Lean Production System (LPS), Lean Manufacturing (LM), Lean Logistics (LL).

1 Introduction

Basque industry in Spain has historically been committed to research and development in production processes, showing leadership in industrial and training technologies, information and communication technologies (ICTs), nanotechnologies, advanced materials, and advanced manufacturing and processes. The region's industry has committed few resources, however, to the development of models that integrate efficient and integrated logistical-productive solutions [1]. Consequently, it is essential to provide industrial organisations with a model that guides them in the integration of dynamics, methods, and tools in the design of logistical-productive processes from a global and integral perspective in order to enhance competitiveness [2].
Furthermore, the ability to design production and logistics processes from a holistic perspective [3] could lead to future operational excellence. The aim of this integration is to achieve adaptable, flexible, and mobile processes [4], and to this end, industrial companies have adopted many strategies, methods, and techniques,

with varying degrees of success. The most successful of these techniques has been the lean production system (LPS) or lean manufacturing (LM) [5]. Consequently, the research team devised and developed a method based on the Line Back Principle (LBP), which can achieve the design of efficient logistical-productive processes in a global and integral way by integrating the principles of LM and lean logistics (LL).

This article describes how a household appliance manufacturing company proved the validity of the LBP by using it to obtain operational improvements. The paper is organised as follows: Section 2 describes the research methodology; Section 3 presents the theoretical framework and explains the LBP; Section 4 describes the LBP debottlenecking process; Section 5 presents the case study; and Section 6 presents the conclusions.

2 Methodology

The methodology followed in this paper is based on 'case study research' [6] in the action research (AR) modality. According to AR methodology, the researcher is a participant in the process and not merely an independent observer—he or she helps create organisational change while studying the corresponding process [7]. To this end, the phases that were followed were a review of the existing literature to identify the key elements of LM and LL, followed by the design of the LBP-EMPHOBEK implementation process. Subsequently, the business and units under study were determined.

3 Theoretical framework

The fundamental principle on which LM is based is the systematic reduction of all operations that do not add value (muda) [8]. To achieve this, it is essential that our organisation—and therefore our value chain—be fully customer-oriented, which means that all efforts must be geared towards satisfying customer needs [9]. On the other hand, LL is about eliminating waste, reducing costs, and striving for perfection to achieve value transfer and create maximum value for users [10]. An important aspect that stands out in both cases is the need to analyse the whole chain from a holistic approach [11].

Value stream mapping (VSM) is a tool that helps perform this analysis in a global way, prioritising the steps and tools to be used at each stage of the lean transformation [12]. However, there is little empirical research on the implementation and management of VSM and, above all, there is a lack of empirical evidence demonstrating the transition from conceptual to realization [13]. Therefore, when dealing with any lean transformation project, we must consider the production and logistics processes in an integrated and not separate way. We must also consider the different lean tools as a group, or globally, since these tools are nothing without the systemic thinking that supports them [14]. Consequently, the LBP is suitable for achieving such integration and prioritisation of actions, as this idea is rooted in the fact that the starting point is consumption and the place of supply of materials is the value-generating process. Therefore, the LBP (Figure 1) deals with optimisation (waste reduction) from the core process (CP) backwards (analysing the entire logistics value chain in reverse, i.e., from the workstation to the supplier) [15–17] using the principles of LM and LL.

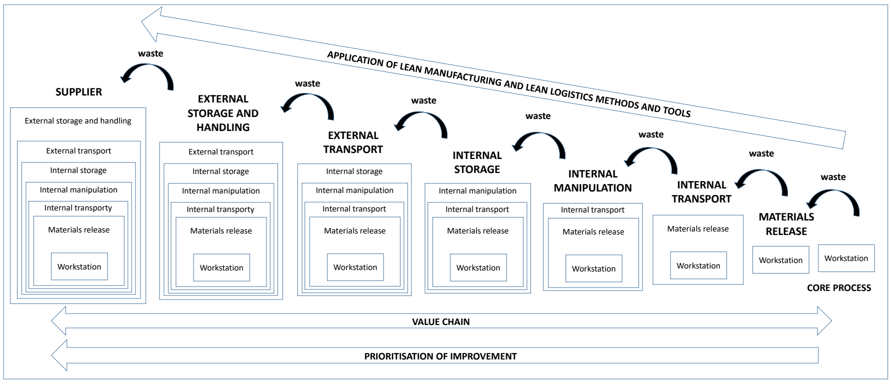

Figure 1: The Line back process, based on [16]

4 The LBP deployment process: PDLB-EMPHOBEK

To integrate the different solutions proposed by the LM and LL as well as under LBP, a systematic and structured process called PDLB-EMPHOBEK has been designed (Figure 2). It consists of the following stages:

STAGE 0: Identification and planning. This involves defining the project team and informing the company management and staff of the scope and implications of the project [18], and determinate de CP.

STAGE 1: Diagnostics of the initial situation. This step consists of analysing the impact of the improvement on the company, starting by determining the production rate, or takt time (TT). After that, the operations carried out at each post are analysed from the points of view of value-added (VA) and non-value-added (NVA) [19].

STAGE 2: Implementation. This stage is divided into three phases:

1. Deciding how to use the programme (i.e., it must be launched only to the core process, or CP, defined in stage 0).
2. Launching the needs to the rest of the links. One criterion is that all parts used in the workstation must be located in the workstation and in a space that minimises operator waste. To this end, we will base ourselves on what we have called the ‘4Bs’: container design, micro-distribution of the

workstation, an information transmission channel, and a supply system.

3. Designing and standardising logistics processes.

STAGE 3: Continuous improvement. Improvement teams are set up. These teams take on daily operational management, so a system of work meetings is established to maintain continuous improvement. To this end, team members must be trained in terms of operational tools and basic management knowledge [20].

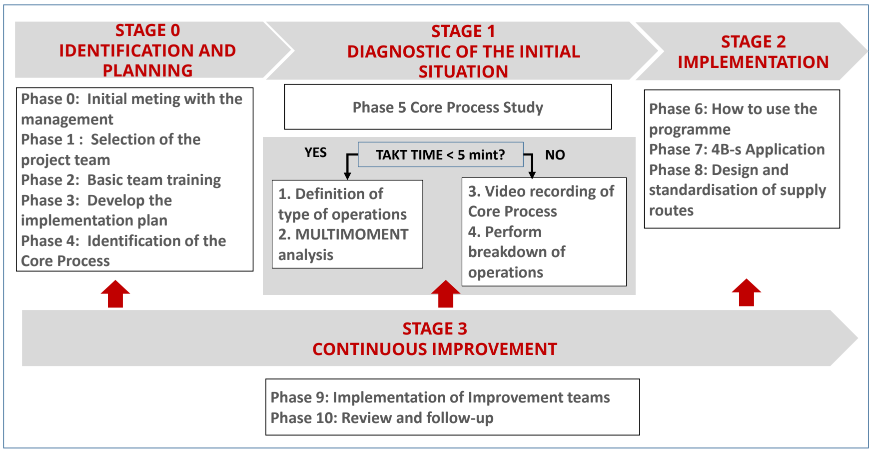

Figure 2: PDLB-EMPHOBEK (own elaboration)

5 Case study: Household appliance manufacturing company

The company that developed this project is a cooperative organisation in Spain's Basque Country. It is a large company, with several plants around the world, and a leader in its sector. The PDLB-EMPHOBEK deployment process was carried out at one of the company's refrigerator manufacturing plants following the steps indicated by the process.

Stage 0: The project team was created, consisting of two industrialisation engineers, two process technicians, two area managers, and the researcher. After that, the team, management staff, and approximately 550 people were trained in aspects related to LM, LL, and the fundamental principles of the LBP. Finally, it was determined that the CP would be the common areas of the assembly lines, where the products enter in a mixed and random manner.

Stage 1: The first variable estimated was the TT at which the assembly lines had to produce, which was 60 seconds. Taking this TT into account, the types of operations the CP stations perform were analysed from a lean VA and NVA perspective, resulting in an improvement potential of a reduction of 3.37 resources per common zone. Therefore, the total resource reduction between the two common zones was 6.74 resources, which represents an improvement in productivity of 12.96%.

Stage 2: To reduce these NVA operations, we followed the deployment process, which determined that 100% of the parts consumed in the stall had to be in the stall and within three linear metres of occupation. To do this, and following the 4Bs, we defined the container to supply the parts, designed the stall shelving, determined the appropriate line supply systems according to the number of references to be supplied and located.

We also designed the system to communicate to logistics and the remaining processes the moment at which to supply and/or produce, thus achieving a pull system. This stage eliminated the need for logistics and the processes manufacturing components for the assembly area to use the programme and decreased space occupied by parts from $144m^2$ to $28m^2$—an 80.55% reduction. We also located 100% of the parts in the workstation. Finally, we defined and standardised supply routes by quantifying their operations time and saturation.

Stage 3: At this stage, the work was quite simple, as the company had been working in improvement teams for years, so the only task was to explain what had been done and why. On the other hand, team members were trained to be responsible—with the support of the project team—for the future improvement of their processes based on LBP methodology.

6 Conclusions and discussion

The results demonstrated the validity of the PDLB-EMPHOBEK process as a means of improving operating parameters. This was done by adopting different logistical solutions in line with the real needs of the production process. Solutions such as the use of Kanban, sequences, commissioning, and/or kittings eliminate NVA operations carried out by the assembly operator: some are taken over by logistics operators and some are taken over by the supplier. This principle is called LBP. At first, this change may generate doubt or tension, as passing certain operations from the production operator to the logistics operator may require an increase in logistical resources. The question is whether the reduction in resources in the production process is greater than the increase in resources in the logistics processes. This is important, since the professional qualifications of employees in the processes differ; the cost of this NVA operation is lower if it is carried out by logistics. Another fundamental aspect of the evaluation and consolidation of this improvement is the standardisation and measurement of logistics processes, a task in which very few companies participate. This is an important step, as it provides a means of knowing whether an operation we want to extract from the production process or CP can be taken on by logistics. In conclusion, by adopting this principle, we can achieve value chains that function as pull systems.

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