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In-plant Logistics Issues and Methodologies Analysis: Case Study

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Abstract

In-plant logistics, unlike other dimensions of logistics, has not been adequately analysed in the literature and practices. Internal logistics, which can be defined as material transportation movements that occur in a closed area by nature, has a high impact on cost, quality and customer satisfaction in the relevant field. Lean logistics is the logistics dimension of lean production. Since logistics activities, like production activities, are ongoing activities, the improvements to be made will have a great impact. This study is presented to both contribute to the gap in the literature and offer solutions to problems related to domestic logistics with a lean perspective. In this study, the solutions offered by a logistics company with problems related to internal logistics and the solutions offered by the author from a lean logistics perspective are included comparatively at the end of the study.

Keywords: In-plant logistics; lean plilosophy; lean logistics; logistics.

1. INTRODUCTION

Unlike other dimensions of logistics, there are not enough studies in the literature on production logistics or In-plant logistics. However, logistics occupies an important place in production activities and directly affects the duration of production and product quality. Companies have entered into a process of simplification to get ahead in the competition. As part of this simplification process, one of the important sources of waste is the waste associated with material transportation. In this context, one of the important issues that come to the fore is how the logistics system should be in a lean production environment. Lean logistics is the logistics dimension of lean production. The simpler, more effective and efficient the logistics activities within the facility are the simpler, effective and efficient the activities within the facility (production, warehouse operations, etc.) will be. Because production logistics directly affects the duration and quality of production in terms of timely and damage-free transportation of the transported products (Ateş and Durmuşoğlu, 2023).

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The concept of in-plant logistics relates to material handling within a large facility such as a factory or warehouse. Facility layout, stock areas in the warehouse, material handling vehicles, order picking strategies, operational rules for the movement of material transport vehicles, affecting internal logistics are factors (Özdağoğlu, 2003).

In-plant logistics, or In-plant logistics as it is commonly used, is an integral part of the activities within the facility. In this aspect, internal logistics; It differs in nature from logistics activities carried out outdoors with vehicles such as ships, trucks, trains or planes. One of the most important points of internal logistics system design is material handling systems. Different types and features of conveying systems can be used in a production system. Material handling is one of the types of waste that has no inherent value added. Choosing an appropriate material handling system here will ensure that this non-value-added process takes place with the least loss.

Material handling activity in a typical industrial enterprise; It includes 25% of all personnel in terms of the number of employees, 55% of the entire factory area in terms of space used, and 87% of the total production time in terms of processing time (Hiregoudar and Reddy, 2007). As can be seen from the relevant percentages, there is a wide area that can be improved and eliminated from waste. Material handling operations and the equipment used for them are complementary elements that must be taken into account in facility layout. It is not possible for them to separate. A change in the material handling system will change the facility layout, and in the same way, a change in the facility layout will change the material handling system (Stephens and Meyers, 2010).

In their study on in-plant logistics, Ateş and Durmuşoğlu found 34 studies on the subject between 2011 and 2022. 7 of these publications are about warehouse functions, 19 are about material transportation vehicles, and 14 are about cell layout - movement between cells. Some publications deal with more than one topic.

2. IN-PLANT LOGISTICS AND MATERIAL TRANSPORTATION

Various definitions are made regarding material transportation. Material handling is summarized by Tompkins (2003) as follows: “It is an activity that uses the right method to deliver the right amount of material at the right place, at the right time, in the right order, in the right position and at the right cost.” This definition explains that the material handling function should be viewed from a broader system perspective rather than a simple material handling activity (Heragu, 2008).

Another definition of material handling is made by the Material Handling Institute. “Material handling includes basic operations related to the movement of solid or semi-solid bulk, packaged or individual products by means of machinery within the boundaries of a work location” (Sule, 1994).

2. 1. Purposes of Material Transportation in In-plant Logistics

Material transportation cost includes a rate between 20% and 70% of the product cost, depending on the material transported. The aim of designing material handling systems should not only be to minimize design and operational costs, but also to create a system that supports other activities in the production area (Heragu, 2008). Sule (1994) stated that the need for material handling systems and careful planning can be attributed to two situations. First, material handling costs constitute a large part of production costs. The latter affects material handling, operations and facility design. In this case, the main purpose of material handling system design can be shown as reducing production costs through efficient transportation. More specifically, the objectives are stated by Sule (1994) as follows:

• Increasing material flow efficiency by ensuring the availability of materials when and where they are needed
• Reducing material handling costs
• Increasing the use of tools
• Improving safety and working conditions
• Simplifying the production process
• Increasing effectiveness

2. 2. Material Handling Principles in Internal Logistics

There are no hard-and-fast rules on how material handling should be carried out. But there are some basic principles. These principles exist in various numbers according to different sources. According to the Material Handling Industry of America, there are 10 principles regarding material handling as shown below (Url-1):

- Planning
- Standardization
- Work
- Ergonomics
- Unit load
- Space usage
- System
- Automation
- Environment
- Product cycle cost

2. 3. Types of Material Transport Vehicles in In-plant Logistics

There are a wide variety of material handling vehicles depending on production environments, production methods and the product to be produced. Heragu (2008) states that choosing a particular material handling vehicle; It states that it varies according to cost, shape, weight, size, volume of loads, space availability and types of stations. It is also stated that the following questions regarding the material handling vehicle become important at this point:

- Does it allow flexibility?
- Is it cheap and easy to maintain?
- Can it be integrated with existing systems?
- Does it significantly increase production efficiency?

The seven basic material handling vehicles can be classified as follows:

- Conveyors
- Pallet carriers
- Freight wagons
- Crane arms, cranes and hoists
- Robots
- AGVs
- Warehouse material handling vehicles (Heragu, 2008).

Selection of material transportation vehicles is also of great importance in designing the internal logistics system.

Using the right tool at the right time, in the right place, in the right way and for the right product is important for the correct design of the system. Basically, material transportation vehicles; It consists of forklifts, check trucks, pallet trucks, trains, conveyor networks and automatic guided vehicles (Kılıç, 2011).

Material transport vehicles can be classified in different ways, mostly similar, in different sources. Hiregoudar and Reddy (2007) classified material handling vehicles as follows:

- Conveyors
- Cranes
- Industrial trucks
- Positioning equipment
- Unit load generating equipment
- Identification and communication equipment

Johansson (1991) suggested that materials can be supplied to an assembly line in three different ways: continuous supply, batch shipment and kitting. Johansson based these three categories on two foundations. The first of these is that even all part types It is included or part of it is included. Secondly, is it based on the part number of the parts or whether it depends on the assembly product or not. These three line feeding types can be found in a system at the same time, but usually only one of them is included. In a study conducted by Johansson in 2006, a line-feeding system called sequential shipping was introduced method has been determined. In this system, parts coming from the supplier are placed on the line in the order of assembly (Sol, 2010).

Mainly for simplifying material handling systems Baudin offered the following steps:

• Creating plans for each part
• Creating the purchased parts market
• Creating distribution routes
• Creating pull signals
• Continuously improving the system (Baudin, 2004).

3. CASE STUDY

The case study is a study that compares the solutions found by the company in question regarding the internal logistics problems experienced by the company and the solutions offered by the author within the framework of the lean logistics perspective on this problem. The company started storage activities in 2000 and transportation activities in 2003. The company purchased self-owned vehicles in 2008 and started international transportation in 2010. In 2014, they expanded their logistics center from 20,000 m^2 to 150,000 m^2. They started railway transportation in 2016 with the purchase of 300 wagons. In 2018, they expanded their storage areas and started medical logistics activities. By starting intermodal transportation services in 2021, the number of self-owned vehicles increased to 350.

Today, FMCG products provide services in many areas, especially in e-commerce, healthcare, automotive and packaging sectors, and offer successful supply chain solutions to their customers, consisting of national and multinational world's leading brands and companies, to provide a competitive advantage in the market. They achieve double-digit growth every year with over 1,500 human resources and over 60 logistics centers across Turkey. The solutions they produced for the internal logistics problems experienced by the company and the solutions produced by the author from a lean logistics perspective are given comparatively in Table 1.

Table 1. In-plant Logistics Issues and Methodologies

Issue	Firm's Solution	Author's Methdology
Faulty product transfers from bonded warehouse to free warehouse	Two solutions are offered. • Importing the entire invoice instead of carrying out the import transactions in parts • Checking the full/empty location in the warehouse after the transfer	Two solutions are suggested. • Product transfer is carried out under the control of an advanced software system (Use of RFID, bar code label) • Limiting partial imports with the software system
Incorrect performance of customs warehouse goods acceptance procedures	Weekly stock count	Transferring the goods acceptance delivery note to the software system and systematically comparing the physical products arriving with the delivery note by scanning the incoming products one by one (manually scanning the bar code with the RF terminal or automatic reading with the RFID system).
Difference between the ordered product and the products collected from the warehouse	Resolving the error by comparing the pallet scanning time and order quantities from the warehouse management system on a collector basis	Automatic transfer of orders to RF terminals via the system and a warning appears in the system if there is a difference between the order and the product collected.
Improperly performing goods acceptance product checks, not preparing a report for the faulty situation	Controlling the time between quantity entry times of pallet scanning information with the warehouse management system	If there is a difference as a result of the systematic comparison of the goods receipt and the physical incoming materials, if a new delivery note or report is not uploaded to the system, the process cannot continue, and the systematic taking of the products into stock is blocked.
Loading products into wrong vehicles	Giving a warning sound via the hand terminal if the bar code of the loaded product and the ramp bar code do not match.	If the scanning procedures are ignored, the loading of the products into the wrong vehicle will continue. Automating these reading processes with the RFID system will reduce errors.

4. CONCLUSION

The concept expressed as internal logistics is a general concept that covers material transportation in a production facility and the movement of stored products within the warehouse. As long as physical production exists, logistics will inevitably exist in line with the need to deliver these products to customers. This study focused on logistics activities taking place within a facility. It is important to re-evaluate the activities in question from a simple perspective and eliminate unnecessary steps that cause waste.

In this context, the problems experienced by a logistics company are mostly related to warehouse activities. The five problems that emerged show that both the personnel cannot fully benefit from the software system and the software system in question cannot fully respond to all the problems of the company. It is a requirement of lean logistics to

avoid manual operations as much as possible, to do repetitive routine physical work with robots, and to do repetitive routine desk work with warehouse management systems. For this reason, improving the software system, installing advanced systems such as RFID systems if possible, and transferring the operations performed by pickers or forklifts to automatic material handling systems should be evaluated.

The company where the application work was carried out has a certain size and is a well-known brand in Turkey. However, the problems they experience show that they do not have sufficient knowledge about lean philosophy in general and lean logistics in particular. If the same situation of not having sufficient knowledge also occurs in other logistics dimensions such as Inbound or Outbound Logistics, it will be revealed that there are many areas where improvement can be made in the company. The gravity of the situation will be understood when other small and medium-sized enterprises that are not of this size are taken into consideration.

As a suggestion for future studies, it will be important to conduct studies that can guide companies in accelerating their transformation in lean logistics. The problems experienced by each company regarding internal logistics may differ depending on the areas in which they operate. However, a study can be conducted based on the common aspects of the internal logistics concept that covers all companies. If necessary, the study in question can be detailed specifically for businesses that have more problems with internal logistics.

Declaration of Competing Interest

The author confirms that there is no known conflict of interest or common interest with any institution/organization or person.

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