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The Reliability of The Transport Process as the Main Factor of Effective Management of the Unified Logistics Supply Chain

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Abstract
In logistics, as a scientific discipline, we can distinguish the following four areas: logistics of supply; production logistics; logistics of distribution; and traffic logistics. Each area, representing a global logistic system, itself consists of many subsystems and individual elements, whose reliable functioning collectively determines the possibility of achieving the final goal with high efficiency. Both inter-element and inter-subsystem connections are diverse. Some of them can be assessed quantitatively, some according to qualitative indicators, and the existence of some can only be assumed. This is the reason why the need arises to impove methods of increasing the reliability of the unified logistic supply chain in order to increase the efficiency of material flow movement.

Keywords: Transportation, Logistics Chain, Reliability, Effective Management

Introduction

In logistics as a scientific discipline, four main spheres can be identified: supply logistics, production logistics, distribution logistics, and traffic logistics. These spheres are closely interconnected, occur sequentially over time, and together form a unified logistics chain for material flow. Each sphere represents a global logistic system composed of numerous subsystems and individual elements, whose reliable functioning collectively determines the overall efficiency and the ability to achieve the system's end goals. Reliability refers to the sustained, quality performance of a component over the longest possible period and it can be applied to every element within a logistic system. The more reliable each sphere's constituent systems, subsystems or individual elements are, the higher the efficiency of the material flow movement chain. The reliability of a unified logistics system differs from that of its individual subsystems and elements due to the influence of various types of connections. These connections can be inter-subsystem, intra-subsystem, intra-element, or inter-element. Considering the interactions that occur through inter-subsystem and inter-element connections ultimately leads to improved reliability of specific subsystem elements or the logistics system as a whole [1-4].

Both inter-element and inter-subsystem connections are diverse. Some can be evaluated using quantitative measures, others through qualitative indicators, while the existence of certain connections can only be assumed. For this reason, there is a need to improve methods for enhancing the reliability of the logistics chain in material flow management. The supply sphere encompasses raw material resources and their initial transportation. For example, consider the paper supply chain to the consumer market. In this case, the supply sphere includes timber harvesting and its initial transportation to common transportation infrastructure.

The next stage involves transporting the wood material from the supply area to the production facility, where it undergoes physico-chemical processing to produce writing paper. During production, semi-finished products are transferred between workshops until the final product is completed and stored in the finished goods warehouse [2-6].

Preconditions and Methods for Solving the Problem

The final stage of transportation moves the finished product to the distribution phase, that is, to the consumer market, where the writing paper is purchased by the end user, and the material flow effectively comes to an end (see Fig. 1.1).

The core activity of logistical spheres is the movement of material flows, both between different spheres and within each sphere. Therefore, to assess the reliability of a unified logistical system, it is essential to evaluate the efficiency of flow movement (i.e., transportation) throughout the entire logistical chain, as the material flow should remain in continuous motion from its origin to its final consumption.

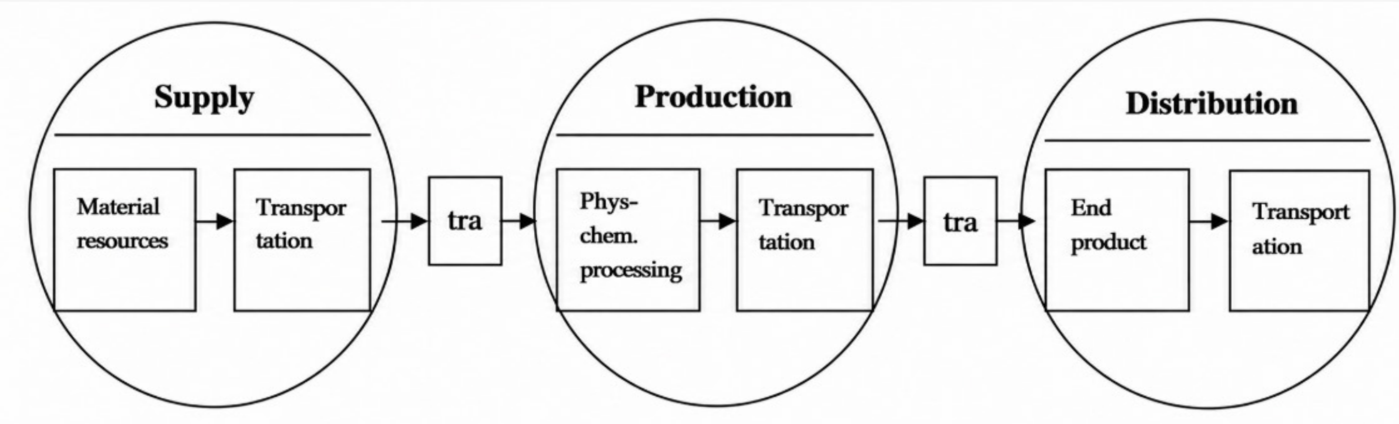

Figure 1.1: The Role and Place of the Transportation Process Within Logistics Spheres and Between Them

According to logistical requirements, the cargo flow should move through all points along its trajectory with consistent speed and intensity. In a unified logistics system, simply accelerating transportation is not inherently beneficial, as it can lead to excessive accumulation or depletion of inventory, which in turn creates challenges in storage, preservation, and protection. Conversely, slowing down transportation is equally problematic, as it can result in shortages in the consumer market.

The reliability of the transportation process is defined by its ability to consistently fulfill its intended functions while maintaining operational, technical, and economic performance within predefined limits that align with specific operating conditions. There are several reasons why the overall efficiency of the transportation process is often lower than the efficiency of its individual components. This is primarily due to organizational and organizational-technical factors, such as shortages of transport vehicles, insufficient load capacity, prolonged loading and unloading times, and increased idle running [3]

There are many reasons why the efficiency of the transportation process may be lower than the efficiency of the individual components involved. This is primarily due to a shortage of transport vehicles caused by organizational or organizational-technical issues. Additional contributing factors include insufficient load capacity, extended loading and unloading times, and increased idle running.

In a unified logistics chain, both in transportation and other spheres, there are inter-element connections characterized by a wide range of application.

According to their purpose, connections can be divided into informational provision and managerial influence. Informational provision between system elements may include components of managerial influence that guide subjects toward better decision-making. Managerial influence connections, on the other hand, can be either directive or prohibitive. They limit the decision-making options of system subjects to a minimum, or completely deprive them of the possibility of choice.

A logistics system comprises diverse elements whose functioning is influenced by various factors and involves certain risks in management. The basic principle of effective logistics system functioning is its reliability at both macro and micro levels. This implies that the risks associated with the system's operation should be minimized, or eliminated entirely.

Logistics risk is understood as the probability of an insurable event occurring due to the sudden failure of a particular element within the system. The reliability of any system is the probability of failure or non-failure. Therefore, the risk inherent in a logistics system or the occurrence of an insurable event corresponds to the well-known concepts of reliability theory. In the insurance system, whose purpose is the functioning of the logistics system with high reliability, management occupies a central place. The logistics system functions as a "human-vehicle" system (Fig.1.2.).

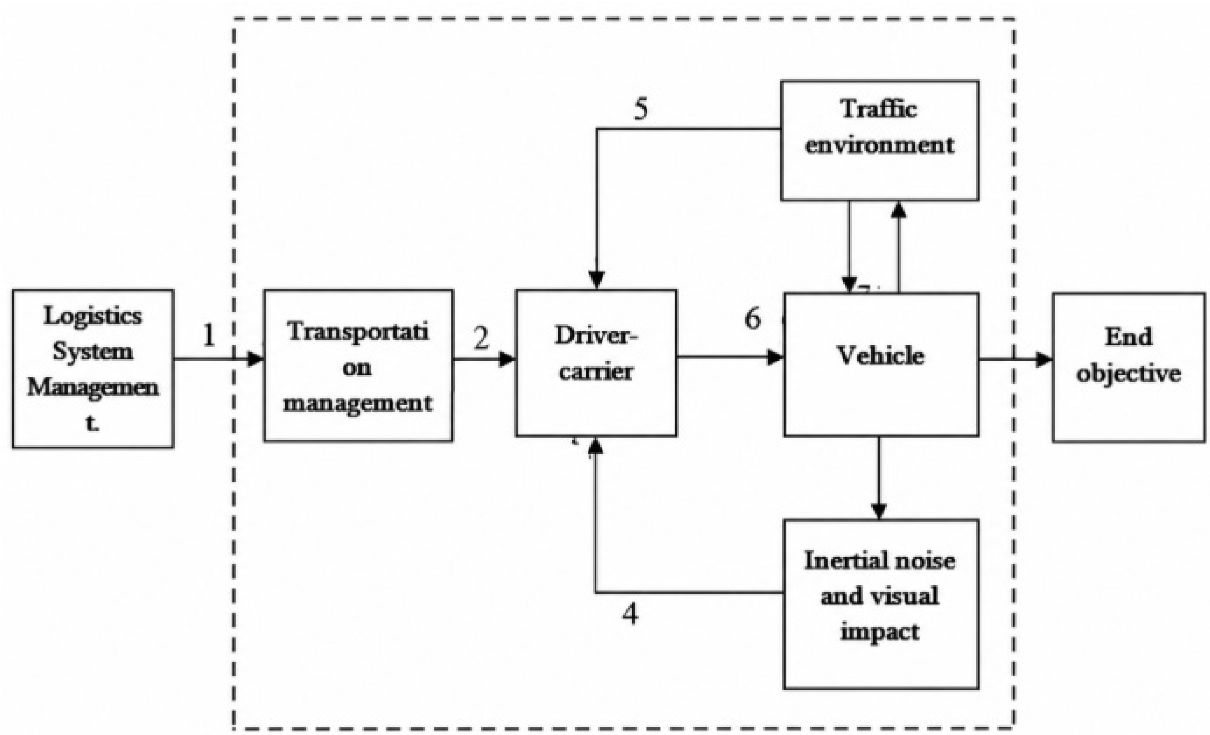

Figure 1.2: Simplified Link of Unified Logistics System "Human- Vehicle".

Through Channel 1, informational and financial flows move toward the transportation management link, which transmits processed and refined information about the completion of the transportation process through Channel 2 directly to the transportation operator. This information should specify the transportation tasks, methods of completion, and final objectives. The first and second channels can be considered partnership channels, since process management occurs on the basis of mutual agreement.

Conclusion

The driver-transporter performs unilateral control of transportation vehicles (Channel 3) to achieve the final goal, during which he takes into account the effects of informational flows received through the fifth channel from the traffic environment (climatic-material and road conditions) and the fourth channel from the transportation vehicles (inertial, noise, specific odor, visual and other effects). Based on the virtual processing of these, he acts on transport control objects through the sixth channel with the aim of managing the transportation process at a high efficiency level. The environment acts on transportation vehicles through the sixth channel, while through the seventh channel it acts in the opposite direction.

The third, fourth, fifth, sixth, and seventh control channels between individual elements of the logistics system can only be coercive, unilateral, and impulsive in nature.

In logistics systems, the following types of risks are identified:

- Commercial risk – including supply disruptions, missed transportation deadlines, and inefficient storage or transportation practices.
- Property loss risk – resulting from adverse natural conditions, including those occurring during transportation.
- Security risk – caused by theft or robbery of material assets, or the hijacking of transport vehicles.
- Environmental risk – associated with the operation of the technical components of the logistics system, including transport equipment. As we can see, the transportation element is involved in every class of risk, and the overall reliability of the system largely depends on its dependable operation. As the transportation process is the main link in any type of logistics activity, its highly reliable operation can be considered the primary indicator of the effective functioning of a unified logistics system.

Thus, in the insurance system, whose purpose is to ensure the reliable functioning of the logistics system, the central role is held by human management of technical systems, with particular emphasis on the management of transportation logistics systems. It is well known that no insurance compensation can fully cover the damage caused by any given risk, as indirect damage inevitably accompanies direct losses. Therefore, insurance compensation alone is insufficient for the complete mitigation of damage. For this reason, the primary task of logistics system management is to prevent the occurrence of insurable events.

The operation of transportation vehicles can be viewed as a system comprising the environment, machine, driver, and operational characteristics. The reliability of this system largely depends on the qualifications, knowledge, skills, work capacity, and physical and psychological health of the personnel. Through their actions, humans can either significantly reduce the occurrence of risks or, conversely, become the cause of system failure and resulting damage. Therefore, when insuring logistics systems, it is essential to consider the reliability of the "human-vehicle" system.

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