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OPTIMIZING TRANSPORTATION SYSTEMS AND MITIGATING RISKS: A COMPREHENSIVE ANALYSIS OF DISTRIBUTION SUPPLY CHAIN CHALLENGES

Summary. The effectiveness of the transportation system aids in the successful economic development of any nation, as studies by foreign scientists have shown that road transport is one of the most critical contributors to budget revenue. Nevertheless, the quality of the products and services offered to the end user affects any company's reputation, market share, and financial stability. Being proactive is essential to ensuring low-risk impact, which entails developing a risk management plan to support the operation through well-defined policies and practices. On the one hand, the company will thus be able to differentiate itself in an often competitive market by implementing an effective shipping protocol that considers and plans risks; on the other hand, it will guarantee its customers a timely delivery, as planned. This article focuses on the various problems affecting the distribution

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supply chain and the negative consequences for the company's image and financial performance.

Keywords: distribution logistics, risk management, company's image, quality of service

1. INTRODUCTION

For most observers, the supply chain today reveals the pertinent level of competition analysis. The latter is based on maximizing revenues and minimizing the costs of making products available to consumers while achieving increasingly short reaction times. This creates a competitive climate, obliging companies, on the one hand, to offer logistics services at prices that ensure better competitiveness and, on the other hand, to adopt a strict policy of cost reduction. Companies are thus compelled to effectively manage stringent constraints on deadlines, flexibility, and the diversity of goods, among other things.

Risk management then became one of the main concerns of carriers and logisticians, especially with the volatility and instability of the global business environment [1].

In this context, through our research work, we aim to provide optimal and responsive decision-making support to help logistics companies and carriers prevent risks related to the distribution supply chain to prevent the rapid onset of acute crises.

Our study begins with the analysis stage, which consists of specifying the general problem related to the outbreak of a crisis at the level of the distribution supply chain in order to identify the leading causes of this crisis and highlight their potential consequences.

Typically, the outbreak of a crisis in a distribution supply chain can be related to the following problems:

- The problem of late delivery.
- The problem of damage to the goods.
- The problem of incorrect delivery.
- The no-load return problem.
- The problems of unavailability of logistics resources and goods at the right time.
- The problems of accessibility to logistics areas (departure or destination area).

We will detail, in the following, the problems mentioned above.

2. IDENTIFICATION OF THE CAUSES OF A CRISIS IN THE DISTRIBUTION SUPPLY CHAIN

2.1. Risk of late delivery

Delivery delays may be due to factors related to the route taken, such as:

- Congestion on the road network [2]
- Road infrastructure characterized by narrow streets [3]
- Restrictions on delivery times [2] and tonnage.

Events can occur and increase the risk of delay, such as vehicle breakdowns, accidents, bad weather conditions, and driver discomfort [4].

Sometimes delays may be recorded with the customer due to a complaint or claim. Delays may also arise from the unloading and loading processes at both the shipper and the customer due to, for example, the unavailability of personnel or facilities unsuitable for loading and unloading or a lack of accessibility [2].

The requisition of the vehicle is also a source of late delivery, as is the type of vehicle used. In fact, for urban deliveries, Heavy Goods Vehicles (HGV) spend an average of 30 minutes for delivery, 20 minutes for Light Goods Vehicle (LGV), and 10 minutes for trucks and cars [5].

Logistics platforms can cause delays if they are located far from customers and recipients or in locations that are difficult to access or even inaccessible [6].

2.2. Risk of damage to the goods

The good condition of the delivered product is of paramount importance for the customer; the latter requires that [7], [8]:

- The packaging is not broken or opened
- Items must be well packaged
- The items show no signs of friction or scratches
- Articles are not overwritten

Goods may deteriorate in warehouses as a result of improper packaging or the occurrence of an adverse incident [9]. Damage to the goods may also occur due to the poor progress of the delivery operation [10].

On its way to the recipient

Several incidents can cause deterioration of the transported goods during the transport of the goods, for example: accidents, collisions, rock falls, theft, bad weather conditions [11], and illegal emigrants in the vehicle transporting the goods. This damage will be considerably more significant if the goods are fragile or perishable [12], [13].

Other damage may occur to the goods being transported, especially if the vehicle used is inappropriate or because of compression due to the stacking of packages or a bad driving habit that can cause shocks that would be as important as the fragile goods being transported [14]. Sometimes, transporting goods over long distances can also cause deterioration of the goods [15].

In warehouses

Stored goods may be damaged in the warehouse for different reasons:

- Planning and organization: Poor organization is responsible for a large number of accidents, on the one hand because load drops, affect both the safety of personnel and the goods [16]. On the other hand, dangerous reactions can also occur if incompatible products are stored in the same area; these reactions can take the form of heat release, combustion, explosion, and the formation of toxic or flammable gases.
- Natural disasters: According to the Disaster Epidemiology Centre (CRED), a disaster is a situation or event that disrupts the normal functioning of regular operations in a region, necessitates external assistance, and results in extensive destruction, damage, and suffering [18]. A natural disaster is caused by geographical, meteorological, climatic events, hydrological and biological (epidemics) [18], and it can be classified according to its

duration into slow-onset or sudden-onset events. Slow-onset events include droughts and famines, while sudden events can include tsunamis, floods, storms, and earthquakes. Natural disasters are increasingly severe for warehouses, given their scale, complexity, frequency, and impact on the building, equipment, and goods in storage [19]. Several factors make the warehouse vulnerable to these disasters; these factors can be summarized in the following table.

Tab. 1

Vulnerabilities of warehouses to natural disasters

Factors	**Description**
Construction of buildings	Non-compliance with building construction regulations to ensure optimal resistance to risks
Weaknesses in prevention systems	Lack of relevant and effective means of prevention (communication, awareness, and instructions)
Means of protection	Lack of means of protection against these risks.
Monitoring and means of alerting	Weak monitoring and lack of means of alerting
Means of rescue	Lack of emergency means
Training	Lack of training for intervention, first aid, rehabilitation

- Fire: The judicious organization of the various equipment that can be held in a warehouse and allocating products to suitable locations considerably reduces the likelihood of industrial risks. Indeed, many incidents of varying severity can occur in warehouses due to the inappropriate ability of existing facilities, deficiencies in internal organization, or misuse of equipment. Fires are considered one of the most dangerous incidents due to their spreading effect, which can lead to long-term loss of control. This usually results in severe physical and human damage. The criteria contributing to the increase in the vulnerability of warehouses to fire are presented in table 2.
- Malicious acts: A warehouse can experience several malicious acts, which could significantly alter customer trust and negatively influence the brand image. Indeed, we identify four categories of risks illustrated in table 3. Several causes increase the probability of this type of accident in a warehouse. We quote: lack of regular care and prevention maintenance means, insufficient guarding, tarpaulin vehicle, unsupervised area, warehouse premises in an unfenced area, knowledge of the value of the commodity, and access controls are not coupled with the intrusion alarm system or CCTV cameras.

Tab. 2

Criteria increasing the vulnerability of warehouses to fire

Factor	Description
The design and internal organization of the building	The internal organization of the warehouse is required to comply with various storage restrictions, such as the separation of incompatible products.

Nature and quantities of existing products	Stored products must be classified to assign them appropriate locations.
Types of packaging materials	the type of packaging used is chosen to reduce the heat load of storage.
Human resources	The staff needs to be sensitized and trained against fire risk.
Handling equipment and installations	It is recommended to regularly maintain the equipment used in the warehouse without forgetting to check the condition of the installations periodically.
Highly inflammatory products	Highly inflammatory products may occasionally be present in a warehouse after development or maintenance work, for example, a formidable danger source.

Tab. 3

Categories of malicious acts risks

Categories	Description
Internal theft	This problem is often felt in a warehouse's different storage and preparation areas, and these disappearances may not be noticed until the inventories are discovered. Most thefts are caused by staff who can easily slip small goods into a pocket or bag, and bulky goods, whose packaging is deliberately shocked, are carried to the dumpster before being picked up at the end of the day.
Theft on the quay	This type of theft can occur during the loading or unloading of goods on the quay or during visits by external people or service providers. Waiting containers and parked vehicles are also affected.
External theft	Points sensitive to intrusion (windows, main doors, emergency exits) can let intruders, sometimes benefiting from internal complicity, to steal several packages. This type of flight concerns the entire site.
Vandalism	This is often the case of an act of revenge (failed intrusion, dismissal, ...) targeting the degradation of equipment or buildings and not the theft of goods.

In the process of loading and unloading operations

During indirect deliveries, the goods are manipulated during loading and unloading operations, and the handling and storage conditions may not be respected, consequently increasing the risk of damage to the transported goods. This hazard will be all the more important if the products handled are fragile [21].

For this reason, minimizing the number of loading/unloading goods [26] and loading and unloading in LIFO mode [27] makes sense. It is also recommended to place fragile goods on top of heavy goods to prevent possible damage [15].

2.3. Risk of erroneous delivery

An erroneous delivery may occur due to an error in the entry of the order information or during the order preparation. Errors in loading operations will also cause incorrect delivery.

2.4. Risk of empty return

After delivering their goods, transport companies are often contractually obliged to make an empty journey [22]. According to the Mobility and Transport Department attached to the European Commission, 23% of all kilometers traveled in 2015 by heavy goods vehicles in the European Union were trips to empty. In the absence of a load, the vehicle must return empty, most of the time at the carrier's expense. This return at Empty is not just a wasted resource in Economics; It is increasingly considered an environmental problem. This problem is due to the weak collaboration between carriers afraid to share confidential information about customers and their orders with collaborators. This prevents them from reaping the benefits of establishing a partnership approach.

In addition, the lack of information-sharing platforms and physical resources between carriers (freight exchanges) hinders any possible collaboration.

In addition, to optimize the physical flow of vehicles and goods, carriers use integrated systems based on new information technologies. This will allow them to guarantee the efficiency of all delivery activities [23]. However, these systems are often expensive, which does not encourage carriers to purchase these systems or pushes them to opt for IT providers offering non-powerful solutions at low prices. In addition, artisanal carriers often work informally and do not perceive the value of procuring sophisticated software.

2.5. Risk of unavailability of logistics resources and goods at the right time

A logistics operation may also be threatened by the risk of unavailability of logistics resources; this unavailability may concern:

- Vehicles: The problem of vehicle unavailability may be related to an insufficient number of vehicles in the fleet or momentary unavailability due to maintenance, for example. Also, undesirable events can occur unexpectedly, such as: breakdown, theft, requisition, or blockage during its journey, and cause vehicle unavailability.
- Drivers: The unavailability of the driver negatively influences the smooth running of the delivery operation. It can be due to illness, strikes, or organizational conflicts.
- The merchandise: Goods may also be unavailable at the time of delivery due to theft during delivery or loss. Losses caused by the theft of goods often involve the transport company's personnel, including order pickers, handlers, or delivery drivers. They can also occur due to organized attacks during the delivery of goods, mainly if these deliveries occur in insecure areas outside peak periods [24]. To guarantee safety, insurance costs are added; in addition, a team of assistants must be present to check vehicles and goods during unloading operations. What contributes to the service's price increase [25].
- The warehouse or exchange point: The unavailability of the warehouse or exchange point may be due to several causes, including: storage capacity saturation problems, lack of handling facilities, presence of long queues to load or unload goods from and to an exchange platform, social movements of internal staff, lack of staff, non-existent or reduced availability due to incidents (fire, vandalism) or natural disasters.

2.6. Problems of accessibility to logistics areas (departure or destination area).

Accessibility to the departure or destination area is influenced by the following:

- Traffic flow: mainly associated with congestion occurring during peak hours when many vehicles condense. This makes access to the city complex and strongly influences the efficiency of carriers [26].
- Road infrastructure: this problem is often felt in the case of urban delivery, as in the city center, the physical dimensions of the streets are generally narrow, and delivery areas are non-existent or small in size that are difficult to locate and often occupied.
- Restrictions: include delivery times, vehicle size, and tonnage of goods transported.

3. IDENTIFICATION OF THE CONSEQUENCES OF POOR RISK MANAGEMENT OF THE DISTRIBUTION LOGISTIC

The distribution supply chain must offer an optimal response to customer demands, despite the ups and downs that can disrupt it. However, achieving this is sometimes very difficult, leading to severe repercussions. These impacts occur on two fundamental levels:

- Financial impacts.
- Impacts on the company's image.

3.1. Financial impacts

The financial consequences relate to the additional costs induced by poor supply chain risk management, visibly reducing the carrier's profitability.

In fact, each risk will eventually have a relatively severe and lasting impact on the company's financial performance [27]. This also concerns the decisions taken, the actions carried out by the actors, the fraud suffered, the operational errors causing a customer complaint to be processed, and the input errors. Everything can cause financial losses ranging from a few euros to several hundred million euros [27].

The problems of a logistics distribution operation have severe financial impacts, as they alter carriers' profitability, reduce their competitiveness, and lead to a loss of resources [28]. These financial consequences relate mainly to generating additional costs, decreases in revenues or revenues, a lousy customer relationship, and a loss of marketplace in the face of competition.

Transport is a key logistics function in the supply chain, contributing 40-60% of logistics costs [29]. These costs can be calculated from equation (1):

$$C_l = C_t + C_s + C_f + C_d + C_r + C_h \tag{1}$$

where:

C_l represents logistics costs.
C_t indicates transport costs.
C_s stands for storage costs.
C_f represents fines due to poor quality service.
C_d indicates impairment costs.
C_r refers to costs related to logistical risks.
C_h represents hidden (latent) costs.

Thus, to evaluate the course of the operation of the delivery of the goods, we can use the following indicators:

- Compliance with order delivery deadlines.
- Customer satisfaction with services.
- The condition of the goods ordered.
- The duration of delivery.
- The performance of the vehicle.

These indicators directly affect logistics costs; compliance with delivery times, the quality of delivered products, and consumer satisfaction with the transport service will significantly reduce logistics costs. The delivery time is crucial because an increase in delivery implies an immediate increase in logistics costs.

Vehicle performance has a noticeable impact on logistics costs, as increasing productivity means reduced transport costs and fewer vehicles used. However, overloaded vehicles carry a high risk of road accidents due to the shifting center of gravity and unequal weight distribution along the vehicle's axes.

3.2. Impact on the company's image

Literature review

In the literature, several definitions exist for the company's image, [30] define the company's image as „A set of meanings by which an object is known and through which people describe, remember and relate to it.». [31] considers it to be "a sum of beliefs, attitudes, and impressions that a person or group has of a company ». In addition, the company's image was identified as "*a factor affecting how people make sense of problems and events and the motivations for acting on them*" [32], [33]. According to [34]: "*It is a model signifying our beliefs and our understanding of a phenomenon or situation*".

According to [35], the company's image can be fabricated and does not reflect the reality of a company. It focuses instead on the company's reputation rather than its image, as reputation addresses social assessments of stakeholders and opinions of a company [36], [37]. Some claim that a corporation's reputation is a component of its image, while others contend that a company's reputation is determined by its constituencies' perceptions of it [37]. Moreover, some even consider these terms synonymous [38].

In this work, we consider that there is no difference between the image and the reputation of the company, and we adopt the definition of Barich and Kotler (1991), who consider that: "the *image of the company is a set of perceptions, experiences, and attitudes that an individual has of a company* ".

Company image and quality of service

The company's image is becoming increasingly critical when offering services; more often, a poor reputation leads to the bankruptcy of service-oriented businesses [39].

The presence of dissatisfied customers degrades the company's image, which negatively impacts the carrier's competitiveness and jeopardizes its existance [40]. Because of this, customer loyalty is often seen as an inevitable problem in managing every business looking for a sustainable presence in the desired market. Then, customer satisfaction is vital since it provides marketers and business owners with an indicator of how to manage and improve their

businesses. By gauging client loyalty, consumer satisfaction can also be used to predict how long a product will continue to be sold or produced. Customers' satisfaction will guarantee business continuity, which means continued operation. Midway through the 1950s, production costs were steadily growing, and the way to keep the company's position in a shifting market and improve earnings started by concentrating on customer service and cost-cutting. As a result, logistics activities have become these organizations' fundamental support system, so the quality of the logistics service offered is seen as a vital factor in the competitiveness of carriers, and that ensures optimal customer satisfaction and increases the chances of captivating new customers.

A good quality of service requires that the goods are delivered in the best quality conditions, cost, and time. The role of logistics in this phase is to ensure proper management of warehousing, to guarantee the quality of the means and conditions of transport, and to ensure that delivery is carried out on time and in place. According to [41], quality of service encompasses quality of staff service, operational service quality, and technical service quality. The result of his research indicates that staff service quality and technical service quality strongly influence customer satisfaction. Additionally, his research believes in a significant connection between customer satisfaction and loyalty.

4. CONCLUSION

In this article, we have examined the various risks threatening the distribution supply chain. We have also focused on their financial impact and influence on the carrier's image.

This comprehensive analysis underlines the importance of optimizing transport systems and mitigating risks in distribution supply chains. This requires leveraging advanced technologies, such as real-time tracking systems, predictive analytics, and artificial intelligence, to improve visibility, optimize routes and proactively manage risks. Furthermore, effective coordination between manufacturers, suppliers, distributors, and transport providers is essential to streamline operations, minimize delays and respond quickly to unforeseen disruptions. Furthermore, implementing sustainable practices can reduce environmental impact and also contribute to cost savings and regulatory compliance.

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