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Last Mile Delivery Challenges and Innovations in Urban Logistics: A Study of the Pallet Industry

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Abstract

One of the most challenging and expensive stages of modern supply chain in last mile delivery. Particularly in large urban areas where traffic congestion, limited infrastructure, and customer's increasing expectations are affecting delivery operations. In palletized logistics, all these challenges are becoming more complex because pallet shipments are of course heavier, as well as large, and requires specialized vehicles for loading, unloading, and transportation.

This research examines all the major challenges that are involved in last-mile delivery of palletized goods with urban environments and it explores all the possible solutions that can improve operational efficiency and also sustainability. Mostly this study relies on academic literature, industry reports, and logistics case studies related to urban freight transportation and the last mile delivery practices.

At the time of analysis it shows how pallet-based deliveries often faces challenges like road(traffic) congestion, restricted unloading areas, longer unloading times, vehicles not available on time, etc. It has strong potential in improving delivery efficiency and reducing environmental impact through micro-distribution hubs, electric vehicles, digital tracking technologies, etc.

The research mainly focuses on palletized freight, which is having less attention in academic studies. Also, findings provide useful understanding for logistics companies, supply chain managers, and policymakers who aim to improve urban delivery systems for supporting sustainable and efficient freight movement in cities.

Keywords: Last mile delivery, Palletized logistics, Traffic congestion, loading and unloading spaces, micro hubs.

1. Introduction

In the past, Logistics industry has experienced various major changes due to rapid urbanization, globalization of supply chains, and also growing demand for faster delivery services. The most important stage in supply chain is last mile delivery, which refers to the final transportation of goods from warehouses/distribution centres to the end customers. This stage though involves shortest distance but it is the most expensive and challenging part of the supply chain. Challenges like traffic congestion, limited infrastructure which are faced by various suppliers.

Last mile delivery logistics is mostly associated with e-commerce parcel deliveries. A large portion of urban freight actually involves palletized shipments, where bulk goods are transported to retail outlets,

warehouses, manufacturing units, and distribution centres. Palletized logistics is very important function of urban economies because it supports movement of products like FMCG goods, food and beverage items, pharmaceuticals, automotive parts etc. Pallet allows goods to transport efficiently. Various equipment like forklifts and pallet trucks can help in handling large quantities of the products.

By having all these advantages, managing pallet deliveries creates operational challenges. Palletized shipments require bigger vehicles, specialized equipment and sufficient loading and unloading spaces. Mostly in populated cities, traffic congestion, restricted parking areas, narrow roads are common things in delaying deliveries and increasing logistics costs. Traditional delivery methods like direct store delivery and large delivery fleets are becoming less efficient in modern urban environments.

Day by day technological developments and environmental concerns are increasing, which encourages logistics companies to adopt new innovative solutions. Different approaches like digital tracking system, electric delivery vehicles, real time tracking systems, micro hubs, etc are evolving to improve delivery times. But the main focus in on parcel delivery systems. Palletized freight movement in urban logistics has very less attention.

Therefore, this research mostly focuses on the pallet industry and the key challenges that are involved in last mile delivery of palletized goods within urban areas.

Research Objectives

1. To identify the major challenges that are associated with last mile delivery in urban areas.
2. To examine technological and operational innovations in urban logistics systems.
3. To analyse possible solutions for improving efficiency and sustainability in pallet distribution

2. Literature Review

One of the important also costly stage of supply chain is last mile delivery. In this stage it involves transporting goods from distribution centres or warehouses to the final customer. According to the research of Gevaers (2014), last mile operations can represent nearly 28-53 percent of total logistics costs, which highlights the need for efficient delivery systems. Various studies on last mile logistics have evolved from focusing on traditional delivery methods to innovating new modern solutions that can include sustainability practices, digital technologies, and data driven optimization. Various researchers like Ollsson, Hellstrom, and Palsson (2019) highlights that technologies are shaping how last mile logistics systems operate.

Urban logistics system faces various operational challenges that can affect delivery efficiency. Most common issues like traffic congestion, lack of parking, loading and unloading space, infrastructure limit, and strict delivery schedules forced by urban regulations. According to Taniguchi and Thompson (2015), increased traffic in populated cities unequivocally increases delivery times. In a similar vein, the study conducted by Holguin-Veras et al. (2015) demonstrates that freight vehicles spend a significant amount of time looking for appropriate pick-up and drop-off locations which in turn results in delayed deliveries and increased operating costs.

Although a substantial amount of the operating literature is devoted to delivering parcels, comparatively less has been done on palletized freight transportation. Palletized shipments contain larger amounts of packaged goods and need specific handling machinery that is able to properly load and unload strips. Rydberg (2020) noted that many urban retail stores do not have sufficient infrastructure for pallet unloading, which can slow down delivery operations and reduce overall efficiency.

Recent literature has also highlighted the growing role of technological and operational innovations in improving last mile logistics. Different solutions such as electric delivery vehicles, route optimization software, real time tracking, and urban consolidations centres are increasingly being adopted to increase delivery performance and reduce environmental impacts in urban areas.

However, in spite of these developments, corresponding limited research has focused especially on pallet based last mile delivery systems, particularly in rapidly developing urban environments. Many studies are still focusing on parcel delivery models which used in e-commerce logistics. As a result, there is clear research gap in understanding the operational challenges and possibly innovations related to palletized freight movement within urban supply chains. This research therefore aims to address that gap by studying the challenges and the likely solutions for improving palletized last mile logistics in urban areas.

3. Research Methodology

3.1 Introduction

Research methodology refers to the structured process that can be used to conduct a study and obtain results. It explains how research is planned, how the information is collected, and how the data is analysed to reach end conclusions. This research focuses on understanding the challenges that involved in last mile delivery within urban logistics, specifically in the case of palletized freight transportation.

Large amount of information is useful on logistics systems that already exists in the form of academic studies, industry reports, and policy documents, but this research mainly relies on secondary data. This research study has a qualitative, descriptive, exploratory, and analytical approach to examine operational issue, technological developments, and possible solutions related to pallet based last mile delivery.

3.2 Research Design

This research uses a hybrid research design that combines both descriptive as well as exploratory methods. Descriptive research design approach is used to explain existing last mile delivery practices, which has common challenges such as traffic congestion, limited infrastructure, and delivery restrictions in urban areas. It also helps to describe logistics systems and operational practices that is used in pallet transportation.

Whereas exploratory research is used to understand evolving trends and innovations in urban logistics. It can help to identify new technologies and solutions like electric delivery vehicles, smart route optimization, micro fulfilment hubs, and smart digital tracker. By combing both approaches, this research provides a understanding of current and future possibilities in pallet based urban logistics.

3.3 Nature and Type of Data

This research is completely based on secondary data, because it is difficult to obtain operational data from companies because it is confidential. In secondary data researcher allows to analyse publishes and verified information from different sources.

The qualitative research approach is used to study the patterns, identify key challenges, and understanding the solutions in pallet based last mile logistics. Various methods like content analysis, comparative analysis, and descriptive interpretation are applied to interpret the collected information.

3.4 Sources of Secondary Data

Information for this research is collected from various available sources. Various academic journals and research databases such as ScienceDirect, SpringerLink, Taylor & Francis, IEEE Xplore, ResearchGate, and Google Scholar were used to review scholarly studies related to urban logistics and last mile delivery. There are many industry reports that have come out from organizations like McKinsey, Deloitte and the

world bank giving us some of the key high level logistics metrics in terms of global trends towards delivery costs or sustainability practices. We also looked at India's National Logistics policy and the PM Gati shakti initiative to find out more on the problems with infrastructure and the rules that affect the movement of freight in cities.

We also looked at company reports and publications from the logistics industry to better understand how to handle multiple pallets and new ways to deliver them.

3.5 Data analysing method

The study primarily uses content analysis and comparative analysis to analyse the data collected. These various methods support the analysis of research findings from different studies, an understanding of common operational challenges, and the study of possible solutions to increase the efficiency of pallet-based last mile delivery systems.

4. Challenges

One of the most important challenging phases is last mile delivery. Especially in the pallet industry where goods are in large quantities and it requires bigger vehicles and specialized handling equipment. In urban areas, delivery of palletized goods are becoming difficult because the populated cities face problems like heavy traffic jams, limited infrastructure, and strict restrictions.

But in all these problems the biggest problem is heavy traffic. In populated cities, delivery vehicles get stuck in the traffic and delays happens due to slow moving traffic and road restrictions. Due to this delivery time increases and also it leads to higher fuel consumption and operating costs. Research suggests that congestion in urban areas can increase delivery time nearly 20-40 percent, particularly for pallet trucks that move slower parcel delivery vehicles.

Another key challenge is the lack of proper unloading infrastructure. Many retail stores and commercial areas in the city does not have much loading and unloading spaces. Due to which drivers have to unload the pallets on narrow roads, which slows down the process and it also increases the chances of product damage or safety for workers.

Retailers have their own timings, which creates difficulty for the logistics companies. Many stores allow deliveries only during limited hours in the morning, which causes several trucks arrives at the same time and it leads to long waiting ques. Whereas parking and city regulations can complicate the situation by preventing vehicles from stopping close to the destination.

Also, an important fear remains the pallet deliveries' high operating expenses. Various expenses related to fuel, skilled labour, unloading equipment, and longer handling time increases the overall cost per delivery. Compared to parcel deliveries commonly used in e-commerce, pallet deliveries require more resources and infrastructure, making them mor expensive and less flexible.

All these challenges clearly indicating that it needs better planning, improved infrastructure, and the use of modern technologies to make pallet delivery more efficient in urban areas.

5. Innovations in Urban Logistics for Pallet Delivery

To overcome these challenges of last mile delivery, many logistics companies are trying to adopt new technologies and operational strategies. All these innovations aim to improve delivery efficiency, reduce costs, and support environmentally sustainable logistics systems.

The use of Electric vehicle (EV) for urban freight transportation can be the most important development. By driving electric vehicles and cargo vans are becoming popular due to less noise, also low emissions,

etc. All these vehicles are good option for short distance deliveries within the city.
Another very important technique is the use of Internet of Things (IOT) and RFID technologies. These smart sensors on the pallet can help the companies to track the shipment in real time. All these technologies make easier to monitor that where the goods are currently, in which state they are, and the way they are moving while transporting. Different logistics companies also use various technologies like route optimization software and artificial intelligence (AI) for making the plan of shipments better. All these systems will look at delivery schedules and the real time traffic data to find out the best route.
Another most important strategy is to create the urban consolidation centres. In this system it uses big trucks to move goods to distribution centres that are close to the border of the city. And from these hubs small vehicles or electric vehicle will take goods to their end destination in the city. By using this method, it can help to reduce the number of big trucks that come in the city which can make the traffic less.

6. Key Findings

1. In urban areas if there is heavy traffic then it will lead to increase in delivery times.
2. Due to insufficient unloading centres in the city many logistics companies face difficulties.
3. If electric vehicles (EV) are used in urban areas then it will help to reduce the pollution.
4. Digital tracking systems should be used by many logistics companies for smooth and better work.

7. Conclusion

In today's era urban transportation is changing day by day because many people are moving towards cities. Also, the movement of goods are increasing, and the customers are expecting faster deliveries. In this research I tried to understand the main challenges and any recent developments in the last mile delivery by examining different research papers, various industry reports, and the real logistics examples.
In this study, last mile delivery is the most difficult as well as the costly stage in the supply chain. In the case of palletized goods this becomes more challenging. Because for palletized goods delivery it requires big trucks, special handling equipment, and also more time of unloading. And in urban area different problems like heavy traffic, limited infrastructure and strict delivery rules also makes the process complicated for many logistics companies.
Also, the study shows that many modern solutions like digital tracking systems, route optimization system, electric delivery vehicles and urban consolidation centres will help to improve the delivery efficiency and also reduction in environmental impact. If all these solutions are used properly with combination of better planning many logistics companies will make the pallet delivery system more efficient and more sustainable.
The future of pallet based last mile delivery will depend on various logistics companies how well they are using the technology. Also, it is very important for logistics companies, government authorities and urban planners to work together so that the delivery system will become more efficient and will meet the increasing demand for urban freight movement.

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