LOGISTIC TECHNOLOGY AND THE CITY LOGISTICS

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Summary: Due to the increasing customer demands for quality traffic, increasing transport volumes and diverse range of possible technologies, logistics provides solutions in freight transport. This article focuses on logistics and information technology, market principles and new trends in the City logistics. Currently, it is important to solve the transport service in the City logistics, distribution models which are a guarantee of new opportunities for optimization of transport in urban areas.

Key words: city logistics, logistics technology, distribution

1. LOGISTIC TECHNOLOGY

The growing flows of freight have been a fundamental component of contemporary changes in economic systems at the global, regional and local scales. These changes are not merely quantitative (more freight), but structural and operational. Structural changes mainly involve manufacturing systems with their geography of production, while operational changes mainly concern freight transportation with its geography of distribution. As such, the fundamental question does not necessarily reside in the nature, origins and destinations of freight movements, but how this freight is moving. New modes of production are concomitant with new modes of distribution, which brings forward the realm of logistics; the science of physical distribution [1].

All operations related to logistics aim at insuring that a demand is satisfied, let it be a part made available to a manufacturer or a good be present on a store's shelf. There are three major categories of logistics operations [1]:

- **Purchase orders processing**. Operations related to the transactional procurement of goods.
- **Stock management**. Operations related to the physical procurement of goods.
- **Transportation**. Operations related to the physical distribution of goods.

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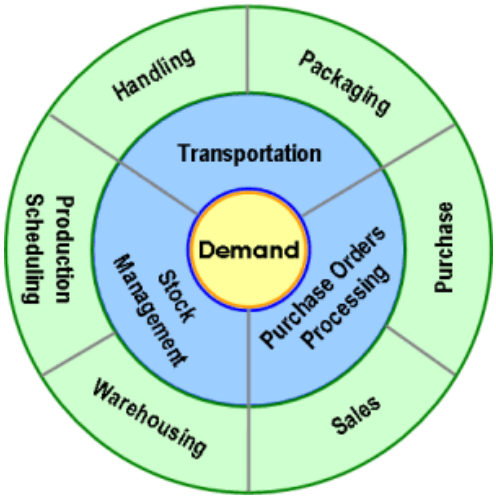

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Fig. 1 - Logistics Operations

2. INFRASTRUCTURE AND TECHNOLOGY

Modern distribution systems require a high level of control of their flows. Although this control is at start an organizational and managerial issue, its application requires a set of technical tools and expertise. If technology can be defined by the level of control over matter, technology applied to logistics can be defined as the level of control of its flows, let them be physical and information related. An important technological change relates to intermodal transportation, particularly containerization, which has been shaping the logistics system in a fundamental way. Containerization is now imbedded within production, distribution and transport [1].

Logistics and integrated transport systems are reciprocal endeavours. More recently, the application of new Information and Communication Technologies (ICT) for improving the overall management of flows, particularly their load units, has received attention. Thus, the physical as well as the ICT parts of technological change are being underlined. The ICT component is particularly relevant as it helps strengthen the level of control distributors have over the supply chain. The technological dimension of logistics can thus be considered from five perspectives [1]:

- **Transportation modes**. Modes have been the object of very limited technological changes in recent decades. In some cases, modes have adapted to handle containerized operations such as road and rail (e.g. double stacking). It is maritime shipping that has experienced the most significant technological change, which required the construction of an entirely new class of ships and the application of economies of scale to maritime container shipping. In this context, a global network of maritime shipping servicing large gateways has emerged.
- **Transportation terminals**. The technological changes have been very significant with the construction of new terminal facilities operating on a high turnover basis. Better handling equipment lead to improvements in the velocity of freight at the terminals, which are among the most significant technological changes brought by

logistics in materials movements. In such a context, the port has become one of the most significant terminals supporting global logistics. Port facilities are increasingly been supported by an array of inland terminals connected by high capacity corridors.

- **Distribution centres and distribution clusters**. Technological changes impacted over the location, design and operation of distribution centres; the facilities handling the requirements of modern distribution. From a locational standpoint, distribution centres mainly rely on trucking, implying a preference for suburban locations with good road accessibility supporting a constant traffic. They service regional markets with a 48 hours service window on average, implying that replenishment orders from their customers are met within that time period. They have become one storey facilities designed more for throughput than for warehousing with specialized loading and unloading bays and sorting equipment. Cross-docking distribution centres represent one of the foremost expressions of a facility that handles freight in a time sensitive manner. Another tendency has been the setting of freight distribution clusters where an array of distribution activities agglomerate to take advantage of shared infrastructures and accessibility. This tends to expand the added-value performed by logistics.
- **Load units**. Since logistics involves improving the efficiency of flows, load units have become particularly important. They are the basic physical management unit in freight distribution and take the form of pallets, swap bodies, semi-trailers and containers. Containers are the privileged load unit for long distance trade, but the growing complexity of logistics required a more specific level of load management. The use of bar codes and increasingly of RFID (Radio Frequency Identification Device) enables a high level of control of the load units in circulation.
- **E-commerce**. Consider the vast array of information processing changes brought by logistics. The commodity chain is linked with physical flows as well as with information flows, notably through Electronic Data Interchange. Producers, distributors and consumers are embedded in a web of reciprocal transactions. These transactions mostly take place virtually and their outcomes are physical flows. E-commerce offers advantages for the whole commodity chain, from consumers being exposed to better product information to manufacturers and distributors being able to adapt quickly to changes in the demand. The outcome is often more efficient production and distribution planning with the additional convenience of tracking shipments and inventories.

Freight distribution is within a paradigm shift between “manufacture-to-supply” (inventory-based logistics or “push” logistics) to “manufacture-to-order” (replenishment-based logistics or “pull” logistics). The paradigm is shifting from maintaining inventories aimed at approximately satisfying the demand to a comprehensive data collection system insuring, mainly through on-demand transport, that supply matches with demand. This trend is strengthened by logistics, namely a better integration between transport modes and inventory control. Of particular relevance to the logistics industry has been the emergence of

major coordinators and integrators (third and fourth-party logistics providers) that have taken the task of improving segments of the supply chain. While a push logistics system involves a limited level of integration between suppliers, manufacturers and distributors, a pull logistics system tries to achieve a higher level of efficiency through integration. Freight flows between components of the supply chain tend to be more frequent, in smaller batches and subject to tight time constraints. In addition, the sharing of demand dependant data (such as sales) helps better synchronize supply with demand. Reverse logistics also tends to be better integrated to achieve a higher level of customer service as well as to promote environmental strategies such as recycling [1].

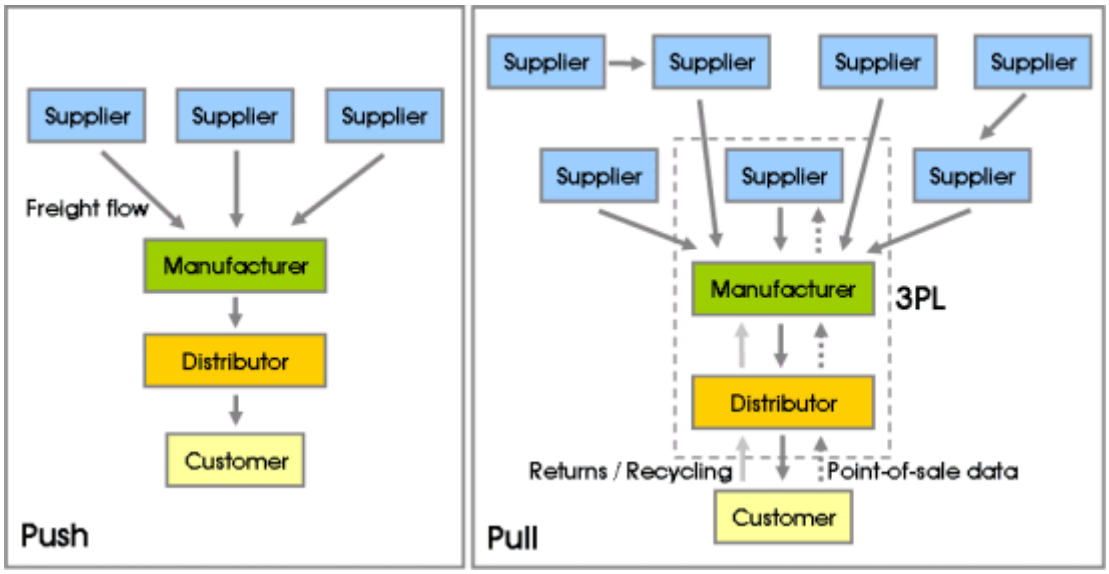

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Fig. 2 - Push to Pull Logistics

Logistics has a distinct geographical dimension, which is expressed in terms of flows, nodes and networks within the supply chain. Space / time convergence, a well known concept in transport geography where time was simply considered as the amount of space that could be traded with a specific amount of time, including travel and transhipment, is being transformed by logistics. Activities that were not previously considered fully in space / time relationships, such as distribution, are being integrated. This implies an organization and synchronization of flows through nodes and network strategy [1]:

- **Flows**. The traditional arrangement of goods flow included the processing of raw materials to manufacturers, with a storage function usually acting as a buffer. The flow continued via wholesaler and/or shipper to retailer, ending at the final customer. Delays were very common on all segments of this chain and accumulated as inventories in warehouses. There was a limited flow of information from the consumer to the supply chain, implying the producers were not well informed (often involving a time lag) about the extent of consumption of their outputs. This procedure is now changing, mainly by eliminating one or more of the costly operations in the supply chain organization. Reverse flows are also part of the supply chain, namely for

recycling and product returns. An important physical outcome of supply chain management is the concentration of storage or warehousing in one facility, instead of several. This facility is increasingly being designed as a flow- and throughput-oriented distribution centre, instead of a warehouse holding cost intensive large inventories.

- **Nodes and Locations**. Due to new corporate strategies, a concentration of logistics functions in certain facilities at strategic locations is prevalent. Many improvements in freight flows are achieved at terminals. Facilities are much larger than before, the locations being characterized by a particular connection of regional and long-distance relations. Traditionally, freight distribution has been located at major places of production, for instance in the manufacturing belt at the North American east coast and in the Midwest, or in the old industrialized regions of England and continental Europe. Today, particularly the large-scale goods flows are directed through major **gateways and hubs**, mainly large ports and major airports, also highway intersections with access to a regional market. The changing geography of manufacturing and industrial production has been accompanied by a changing geography of freight distribution taking advantages of intermediary locations.
- Networks. The spatial structure of contemporary transportation networks is the expression of the spatial structure of distribution. The setting of networks leads to a shift towards larger distribution centres, often serving significant trans-national catchments. However, this does not mean the demise of national or regional distribution centres, with some goods still requiring a three-tier distribution system, with regional, national and international distribution centres. The structure of networks has also adapted to fulfil the requirements of an integrated freight transport demand, which can take many forms and operate at different scales. Most freight distribution networks, particularly in retailing, are facing the challenge of the "Last Mile" which is the final leg of a distribution sequence, commonly linking a distribution centre and a customer (store).

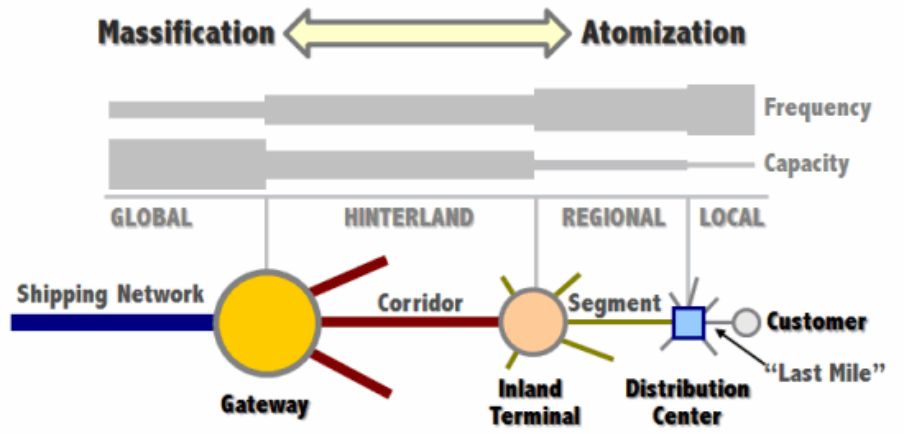

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Fig. 3 - The „Last Mile“ in Freight Distribution

3. FREIGHT DISTRIBUTION AND NETWORK STRATEGY [1]

- **Point-to-point** distribution is common when specialized and specific one-time orders have to be satisfied, which often creates less-than-full-load as well as empty return problems. The logistical requirements of such a structure are minimal, but at the expense of efficiency.
- **Corridor** structures of distribution often link high density agglomerations with services such as the land bridge where container trains link seaboards. Traffic along the corridor can be loaded or unloaded at local/regional distribution centres, acting as sub-hubs in this distribution system.
- **Hub-and-spoke** networks have mainly emerged with air freight distribution and with high throughput distribution centres favoured by parcel services. Such a structure is made possible only if the hub has the capacity to handle large amounts of time-sensitive consignments. The logistical requirements of a hub-and-spoke structure are consequently extensive as efficiency is dominantly derived at the hub’s terminal. Commonly, a major distribution centre located at the hub will have privileged access to a terminal.
- **Routing** networks tend to use circular configurations where freight can be transhipped from one route to the other at specific hubs. Pendulum networks characterizing many container shipping services are relevant examples of relatively fixed routing distribution networks. Achieving flexible routing is a complex network strategy requiring a high level of logistical integration as routes and hubs are shifting depending on anticipated variations of the integrated freight transport demand.

Since cities are at the same time zones of production, distribution and consumption, the realm of city logistics is of growing importance. This issue is made even more complex by a

growing dislocation between production, distribution and consumption, brought by globalization, global production networks and efficient freight transport systems (increasingly by logistics) [1].

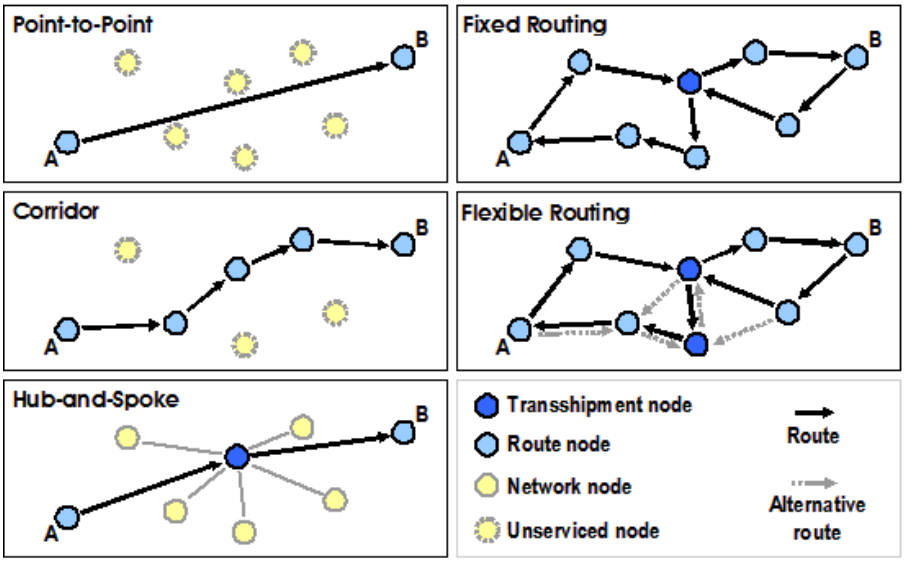

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Fig. 4 - Network Push to Pull Logistics

4. THE CITY LOGISTICS

City logistics, as a distributional strategy, can take many forms. On the above figure, a high density and congested central city can be serviced by an independent freight distribution system calling from a terminal located at the margin. The vehicles used to service the customers (either for deliveries or pickups along a flexible route) are likely to be smaller and thus better adapted for distribution in an urban environment. There is also the possibility of using the existing public transit system to move freight but this implies several challenges in terms of the adaptation of modes, the usage of existing passenger's terminals and scheduling issues. The urban terminal itself could be a neutral facility interfacing with a set of distribution centres, each being connected to their respective supply chains. Thus, a wide array of supply chains connected to the city can achieve a better distributional efficiency within the central city [1].

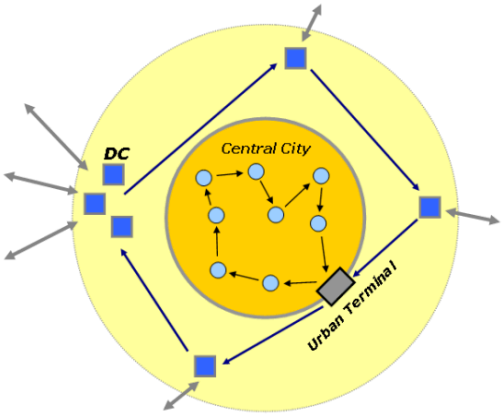

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Fig. 5- City Logistics

5. THE DISTRIBUTION MODELS FOR THE CITY LOGISTICS

The distribution logistics is the link between production and sales entities. It includes all warehouse and traffic movements to the consumer (customer) and the related information, management and control activities. The aim is to be able to deliver the right goods at the right time at right place at the right quantity and quality, while creating optimal balance between a set of delivery services, which is able to provide business or the customer is required, and the emerging costs. This is a good serving trade channels. Currently, the company improved the supply of services seeking competitive advantage. We must take account of the requirements of customers, which mostly consist of providing additional services such as storage or training range. The customers are increasingly looking to reduce their stocks, and these reasons prefer orders in smaller quantities and shorter intervals at the maximum synchronization needs. This makes supply companies to develop appropriate delivery strategies to ensure high delivery readiness without also occurred cost increases. The main areas of distribution logistics are focused on the choice of habitat distribution depots, storage, and packaging economy, output of goods and making loading and transportation activities.

The key to effective management of the logistics process is the concept of the total cost. The business entities in this context should not focus on isolated individual logistics activities, but must try to reduce the total cost of logistics activities. Management must deal with the consequences of their decisions for all items or categories of logistics costs.

The logistics aim is to minimize total costs while achieving the necessary level of customer service. The total cost is the cost of transport + storage cost + cost of handling orders and quantitative information system + cost + cost of maintaining stocks.

The fundamental challenges in addressing the problem of distribution models in urban logistics is where, how and what goods will be transported to the city centre or in the agglomeration.

Depending on the quantity of goods, special time and quality requirements, we can provide the following basic models for the transport service in urban (city) logistics:

- the direct supply,
- the distribution through corporate or wholesale warehouse,
- the distribution through the transit terminal,
- the distribution through the transit terminal in combination with small containers (safes), located in the centre of the city,
- the distribution through the establishment of a transit terminal outlet next to the terminal.

5.1 The Direct Supply

The goods are shipped directly from the manufacturer to the final customer without intermediate storage. The system known as a conventional transmission chain in which it is carried out in parallel supply and distribution. The direct supply (Fig. 6) is a possible option for shops, where logistics concepts are implemented in our own supply of responsibility now.

The customer reaches driven commodity flow, where each order is delivered from suppliers to ramp gateway customers.

The advantages of the direct supply are:

- Logistics meeting request recipient,
- Removal of transhipment,
- In a coordinated supply of commodity flow.

The disadvantages of direct supply are:

- Problem with using the transport capacity,
- Increased organizational costs for the business organization responsible for their own supply,
- Often higher number of shipments in small units and thus increase the burden on roads and transport.

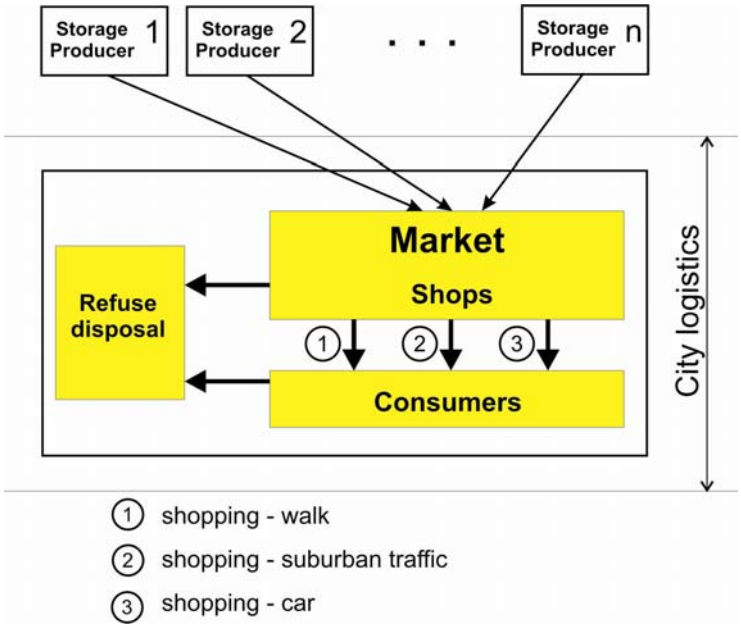

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Fig. 6 - The direct supply in City Logistic

5.2 The Distribution using the external Storage

This model is a multi-stage distribution system. Goods are shipped from the manufacturer or from a central warehouse via the external (regional) stock (Fig. 7) to the shops located in the centre of town. The term is meant a branch of external storage warehouse, distribution warehouse, warehouse or regional dispatching warehouse.

Compared with the direct supply of this model generated a much lower cost. With regard to the binding capital goods do not arise from this model is no rationalization option. The establishment of warehouses near the commercial suppliers, while the network will make it easier to address the legitimate demands of beneficiaries, but that option does not constitute any rationalization. The costs of holding stocks are always moved and will increase the total logistics costs. Trend is clearly to fewer central warehouses respectively external stores.

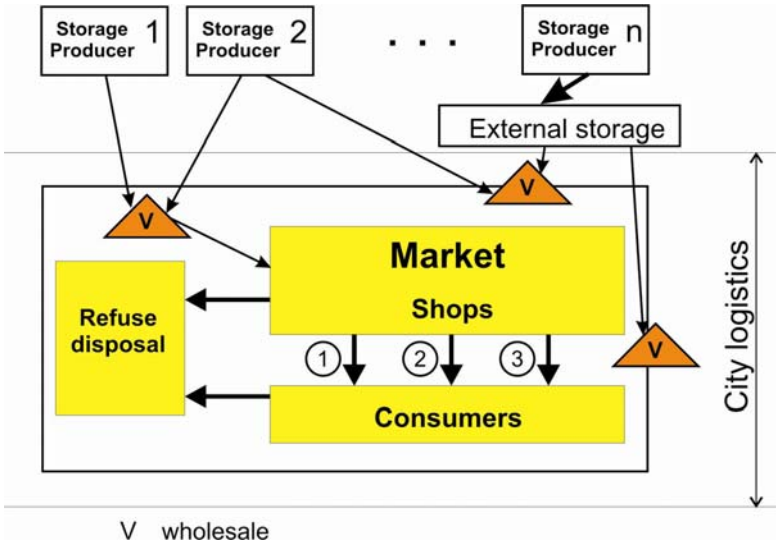

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Fig. 7 - The Distribution using the external Storage in the City logistic

5.3 The Distribution using the Transit Terminal

This distribution model is the role of the transit terminal (Fig. 8) the passage of goods, preceded by a distribution service, specifying the city or agglomeration. Transit terminal assumes no storage function in the normal range, but in most cases, act as buffer stock. Goods, but may be short and to the references stored in the JIT technology supplied to final customers. The transit terminal (warehouse) goods bring into production or central warehouse in large volumes. Bulk supply of goods can be used by rail transport, which in this case offers quantity discounts and transportation costs are significantly lower than road transport. Undisputed advantage is the ease road congestion and lowers the burden on the environment. The transit terminal is connected to the demand for transport infrastructure in at least two modes. The location of the terminal for international rail corridors is required to reflect the additional requirements for the use of combined transport. They can be applied to a large extent, swap bodies. The transit terminal and commissioning goods delivered to stores according to their requirements operating lower categories of road vehicles. Take away travel are set and managed on the basis of the service sightseeing tours. The transit terminal is located on the outskirts of town to the road to it was complicated approach.

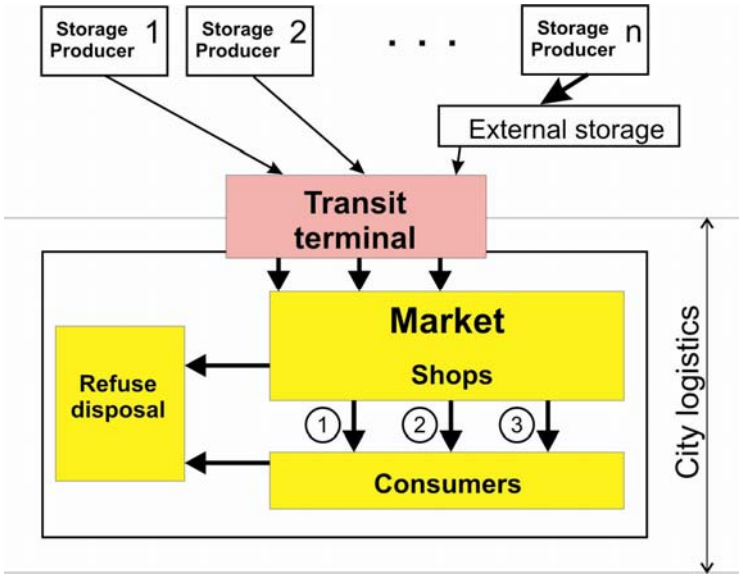

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Fig. 8 - The Distribution using the Transit Terminal in the City Logistics

5.4 The Distribution through the Transit Terminal with the Rack storage system

The distribution of goods through the rack reservoirs (Fig. 9) or safes, they are located in the vicinity of consumers in the city centre. It is the model in which each consumer goods (customer) collects itself or through a paid service called external provider of the logistics performance. The goods are stored in compartments in the time window that does not affect the normal life of the city.

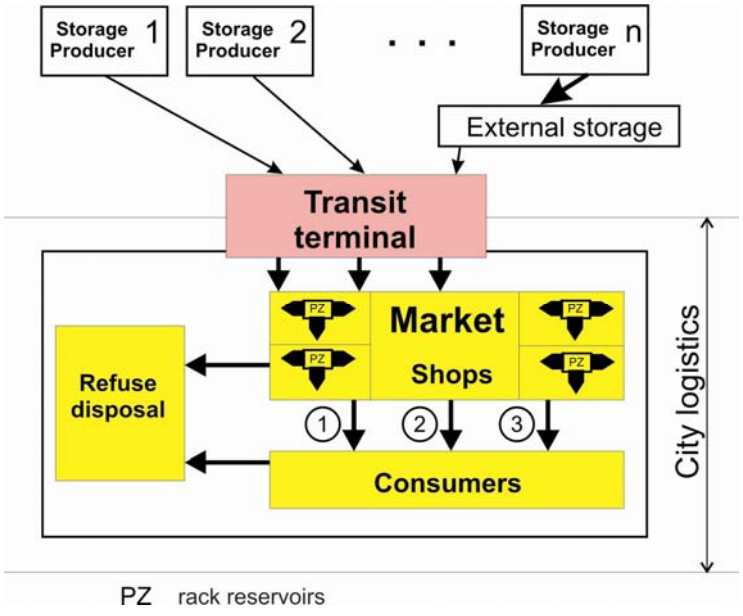

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Fig. 9 - The rack reservoirs in the City logistics

6. ACKNOWLEDGEMENTS

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