

# Classification System for a Collaborative Urban Retail Logistics

Volker Lange, Stephanie Moede, and Christiane Auffermann

**Abstract**—From an economic standpoint the current and future road traffic situation in urban areas is a cost factor. Traffic jams and congestion prolong journey times and tie up resources in trucks and personnel. Many discussions about imposing charges or tolls for cities in Europe in order to reduce traffic congestion are currently in progress. Both of these effects lead – directly or indirectly - to additional costs for the urban distribution systems in retail companies. One approach towards improving the efficiency of retail distribution systems, and thus towards avoiding negative environmental factors in urban areas, is horizontal collaboration for deliveries to retail outlets – Urban Retail Logistics. This paper presents a classification system to help reveal where cooperation between retail companies is possible and makes sense for deliveries to retail outlets in urban areas.

**Keywords**—City Logistics, Horizontal Collaboration, Urban Freight Transport, Urban Retail Logistics.

## I. INTRODUCTION AND PURPOSE

EUROPE'S cities are growing constantly. By the year 2050 more than 80 percent of the population will be living in cities [1]. While the volume of traffic is continually on the increase, the road traffic infrastructure has often remained the same. The increasing density of traffic [2] leads to more traffic jams, noise pollution and environmental impacts in urban areas. From an economic point of view this situation represents a cost factor for companies. Traffic jams and delays mean longer journey times which tie up trucks and personnel. More and more discussions are being held about levying charges or tolls for urban areas in Europe, which on the one hand are intended to reduce traffic congestion and, on the other hand, include an ecological component to reduce noise and air pollution [3]. For the retail companies' distribution systems this is a cost factor which can have a direct or indirect financial impact due to tolls and charges or because of longer delivery routes. One approach towards avoiding negative environmental influences and towards improving the efficiency of urban retail distribution systems is horizontal collaboration among retail companies delivering to their

outlets – Urban Retail Logistics. In contrast to the term city logistics, which has previously been used in such investigations, this approach relies on direct cooperation between the retail companies which actually run the distribution systems.

This leads to the question of which retail formats are suitable for Urban Retail Logistics. Due to the permanent changes which retail formats and distribution logistics undergo, this question cannot be answered definitively once and for all. Indeed those involved will have to put this question to themselves again and again. For this reason, this paper will present a two-dimensional classification system which makes it possible to use generally valid criteria to examine where horizontal collaboration is both possible and makes sense among retail companies in the field of urban freight transport. This system comprises two aspects or dimensions. Firstly, the retail dimension documents the different types of retail outlets in urban areas. The second dimension is the logistics aspect which documents the requirements profiles when delivering to retail outlets in urban areas.

A comprehensive overview of urban freight transport initiatives which have been presented in the relevant literature is provided by Quak [4]. He examines the initiatives with regard to their contribution towards sustainable urban freight transport. Allen et al [5] present an approach for the general analysis of urban goods and services flows, but do not present an approach of their own towards how urban freight transport could be designed. Other publications describe the practical implementation of urban freight transport initiatives without presenting the theoretical basis for cooperation [6], [7], [8]. Ogden [9], Nuzzolo et al [10] and Marchau et al [11] investigate a calculation or analysis model for the applicability of urban goods distribution, but do not show which type of goods and which delivery points are suitable for bundling in this way.

This paper contributes towards closing the gap between analysis and implementation. It proposes a classification system which can help to examine where cooperation between retail companies is possible and makes sense when delivering to retail outlets in cities. It makes it possible to achieve structured documentation of retail goods flows in urban areas and to use this to ascertain the potentials for cooperation.

The following section defines the subject matter and positions the classification system within research into logistics and retail institutions. The section on the two-dimensional classification system describes how the system

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functions on the basis of the retail and logistics dimensions. The conclusions indicates potential users and details possible further research activities in the field of Urban Retail Logistics.

## II. OBJECT OF INVESTIGATION

In order to examine the possibilities of inter-company collaborative deliveries to retail outlets in urban areas, it is essential to take a comprehensive approach which looks into the systemisation of retail outlets from the point of view of logistics as well as from the point of view of research into retail institutions. The classification system here refers exclusively to the sectors of wholesale and retail with retail outlets in urban areas. As far as logistics is concerned, it is the last section of the supply chain which is relevant here. This ends in the retail outlets and begins – depending on the particular distribution strategy – in the manufacturer's warehouse (direct delivery), in the retail company's distribution centre (distribution centre delivery) or at the cross docking platform (cross docking delivery). This classification system considers every type of retail outlet separately. If a particular enterprise has several different types of retail outlets, these are to be considered separately, as any deviating systemisation criteria could have an effect on either or both of the retail and logistics aspects.

## III. TWO DIMENSIONAL CLASSIFICATION SYSTEM

### A. Retail Dimension

In this two-dimensional system, the retail dimension's task is to classify the retail outlets which are found in urban areas. In the relevant literature different criteria are taken into consideration [12], [13], [14]. The aim of this system is to create a structured analysis of the goods flows in urban areas to enable horizontal collaboration between retail companies within their urban distribution systems. To achieve this, five criteria are used which are suitable to distinguish the requirements of different distribution systems (Fig. 1).

The first two classification elements here are the economic sector and the contact principle. The economic sector describes which economic field the company in question belongs to (retail, skilled crafts and trades, industry or services). The contact principle, which originates from Hansen's system [14], describes the type and place of contact between the customer and the company's staff. There are four levels within this criterion. The residence principle applies if the customer visits the company, i.e. (classic) over-the-counter retail. In contrast to this there is the domicile principle when the retailer visits the customer at his/her home. In the meeting principle the two parties meet outside both of their premises – street markets are the best known example of this. The distance principle describes the situation when the customer and retailer do not have any direct contact with each other. In

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The business in question is then defined more precisely using the main goods and range of goods criteria. The main goods criterion describes the main types of goods usually sold by the retailer under a central heading (e.g. food, Do It Yourself-products (DIY-products), clothing, shoes, furniture etc.). The range of goods criterion is a key figure which describes the number of different articles offered by the company. This initial classification makes it possible to consider the fundamental suitability of utilizing collaborative deliveries to retail outlets. For example, it is clear that cooperation between a frozen food specialist and a book-seller is not usually worth considering.

In order to decide whether joint deliveries are worth it, one level of detail is still missing from the retail dimension. This is the assortment categories. The status of the classification so far tells us, for example, that the main goods for the supermarket retail outlet are food. However, on the operational level of deliveries to retail outlets in urban areas, this level of aggregation is too high and must undergo further differentiation into assortment categories. This is because normally the main goods criterion does not document the whole assortment offered by one retail outlet, or not the whole assortment within a main goods category are offered for sale. This is why there is a second level of assortment within the retail dimension. This includes a total of 60 assortment categories and defines the main goods in detail. From a logistics point of view, it can be necessary to treat the individual assortment categories differently too (storage / handling / transport). Taking the main goods category of food as an example, this could actually mean the transport of different goods with different temperature requirements. These criteria are taken into account within the logistics dimension.

Overview level				Detailed level
Economic sector	Contact principle	Main goods	Range of goods	Assortment categories
Industry	Residence principle	e.g. food	e.g. 20 000 articles	e.g. fruit / vegetables
Skilled crafts and trades	Domicile principle	e.g. furniture	etc.	e.g. hanging garments
Retail	Meeting principle	e.g. shoes		e.g. watches / jewellery
Services	Distance principle	etc.		etc.

Fig. 1 Differentiation criteria for the systemisation of the retail dimension

This paper only considers retail outlets in urban areas, so the question might arise as to why the criteria of economic sector and contact principle are included in this system. Within the scope of this paper, the characteristics of these two criteria have already been determined. The economic sector is defined as retail and the contact principle is defined as the residence principle. However, one aspect of this work also involves extending the classification system to other sectors and forms of retail in urban areas, so this initial differentiation can be used to include service companies as well as skilled trades companies and their freight traffic. Other forms of retail can also be included which are defined in the distance principle – i.e. classic mail order and online retail businesses.

### B. Logistics Dimension

The retail dimension systemises retail outlets in urban areas and allocates assortment categories to them. The logistics dimension has the task of systemising the logistics

requirements of a delivery to retail outlets. The aim is to document all the logistically relevant criteria for operational deliveries to retail outlets in urban areas. In the relevant literature, examples or a selection of important logistics criteria can be found [15], [16], [17], [18], however the authors do not make any claim to completeness. For this reason, in addition to the literature research which has been conducted, interviews with experts were also carried out to validate the logistics criteria and to adjust them to meet the requirements of deliveries to retail outlets in urban areas.

The logistics criteria can be divided into five requirements categories (Fig. 2). The volume requirements category documents the details of the average quantity of goods delivered to the retail outlet. In the loading device requirements category, the types of loading devices are defined which have to be handled during a collaborative delivery (e.g. europallet, half pallet, roll containers etc.).

Volume requirements	Loading device requirements	Goods requirements	Retail outlet requirements	Network requirements
e.g. 20 europallets	e.g. europallets	Temperature requirements	Delivery frequency	Distribution strategy
etc.	e.g. half pallets	Vehicle requirements	Time window requirements	Quality assurance system
	e.g. roll containers	Equipment requirements	Vehicle requirements	Return logistics
	etc.	Hazardous goods	Equipment requirements	Waste disposal logistics
		Valuable goods		

Fig. 2 Requirements categories for the systemisation of the logistics dimension

The goods requirements category summarises all the criteria which are directly related to the product. This includes the following criteria:

- Temperature requirements
- Vehicle requirements (e.g. lifting platform, box truck, etc.)
- Equipment required (e.g. fork lift, hand pallet truck, etc.)
- Hazardous goods

- Valuable goods

Temperature requirements are specified if the goods must not exceed or fall below a certain temperature (e.g. frozen foods, paint, varnishes etc.). The characteristics of the goods could mean that special vehicles or equipment are needed, which are then to be entered under these points (e.g. a truck with curtain tarpaulins for loading/unloading long sized goods from the side). The criteria hazardous goods and valuable goods are goods characteristics which demand special handling during the distribution process.

The category of retail outlet requirements bundles the criteria which can be derived from the special situation or requirements at the retail outlet. These include:

- Delivery frequency (e.g. daily, weekly, etc.)
- Time window requirements (e.g. between 6 am and 10 am)
- Vehicle requirements (e.g. lifting platform, box truck, etc.)
- Equipment required (e.g. fork lift, hand pallet truck, etc.)

Delivery frequency provides information about the frequency of deliveries to the retail outlet. The time window requirements documents whether a defined time window for deliveries must be adhered to. The criteria for vehicle requirements and equipment requirements are allocated to both of the previously mentioned categories because restrictions regarding the means of transport and the equipment could be due either to the goods being transported or to the building and/or technical equipment on site at the retail outlet.

Network requirements summarises the criteria which apply to the distribution system and its organisation. These are:

- Distribution strategy (e.g. direct delivery, distribution centre delivery, cross docking delivery, etc.)
- Quality assurance system (e.g. hazard analysis and critical control points-concept (HACCP-concept), temperature logger, etc.)
- Return logistics (e.g. centralized return to the distribution centre, return by service providers, etc.)
- Waste disposal logistics (e.g. central waste disposal at the distribution centre, direct disposal at the retail outlet, etc.)

The distribution strategy criterion provides information about how the goods get to the retail outlet. The quality assurance system criterion includes both quality assurance concepts which have to be ensured during collaborative deliveries (e.g. HACCP-concept), as well as the technical installations which serve to monitor product quality (e.g. temperature loggers). The return logistics and waste disposal logistics criteria define the reverse flow of goods and loading devices (return logistics) as well as recyclable material flows (waste disposal logistics) from the retail outlet.

The logistics dimension combined with the retail perspective defines a matrix which can be used to fully document the retail outlets as regards their requirements for goods deliveries (Table I). This provides the basis for Urban Retail Logistics by showing similarities and differences in the distribution needs of different retail companies and thus revealing potentials for cooperation.

TABLE I  
MATRIX FOR THE SYSTEMISATION OF DELIVERIES TO RETAIL OUTLETS

		Assortment categories within the retail dimension				
		<i>Fresh meat</i>	<i>Personal hygiene / cosmetics</i>	<i>Folded goods</i>	...	
Requirement categories within the logistics dimension	<i>Volume requirements</i>	Volumes [Europallets]	2	1	3	...
	<i>Loading equipment requirements</i>	Loading devices	Europallet	Europallet	Europallet	...
	<i>Goods requirements</i>	Temperature requirements [°C]	2 - 4 °C	-	-	...
		Hazardous goods	no	no	no	...
		Valuable goods	no	no	no	...
		Vehicle requirements	Refrigerated	Lifting platform	Lifting platform	...
		Equipment requirements	Hand pallet truck	-	-	...
	<i>Retail outlet's requirements</i>	Delivery frequency	daily	weekly	weekly	...
		Time window requirements	6.00 h to 8.00 h	10.00 h to 14.00 h	10.00 h to 20.00 h	...
	<i>Network requirements</i>	Distribution strategy	Distribution centre	Cross docking	Cross docking	...
		Quality assurance system	HACCP	-	-	...
		Return logistics	central	central	central	...
		Waste disposal logistics	decentral	central	central	...

## IV. CONCLUSION

The two-level systemisation within the retail dimension enables in the first step a fast, aggregated assessment of the potential for cooperation to be carried out, which can then become more detailed as it is taken right down to the assortment level in the second step. In the five requirements categories within the logistics dimension, all the criteria are defined which need to be documented for deliveries to retail outlets in urban areas. With the aid of the two-dimensional classification system presented here, it is possible to identify where there are potentials for horizontal cooperation between retail companies for delivering to retail outlets in urban areas. The goods traffic flows of retail companies in cities can also be documented and structured in order to find out how they function and about possibilities for bundling them.

This classification system can be used by retail companies who want to find out about the potentials for collaborations in the context of Urban Retail Logistics. It is also suitable for the public sector when planning initiatives for bundling urban delivery traffic, because the system presented here can identify potential participants together with their goods volumes. Finally, the classification system can also be used by logistics services providers which offer Urban Retail Logistics as a service.

The concept of Urban Retail Logistics aims to utilise horizontal collaboration between retail companies when delivering to retail outlets in order to reduce traffic congestion and its negative impacts in cities. The two-dimensional classification system presented here is a first step providing a structured analysis and documentation of goods flows in the retail trade in urban areas. There is a need for more research in the context of Urban Retail Logistics and particularly in the development of concepts for the operational implementation of such plans for bundling deliveries. And to improve the effect of bundling deliveries even more, there is a need for research in shifting deliveries to retail outlets to times when there is not so much traffic.

## REFERENCES

- [1] United Nations, Department of Economic and Social Affairs, Population Division (2011) World Urbanization Prospects, the 2011 Revision. [http://esa.un.org/unup/Analytical-Figures/Fig\\_1.htm](http://esa.un.org/unup/Analytical-Figures/Fig_1.htm). Accessed 17 December 2012
- [2] Bundesministerium für Verkehr, Bau und Stadtentwicklung (ed) (2011) Weißbuch Innenstadt – Starke Zentren für unsere Städte und Gemeinden, Berlin, Bonn, pp 40-41
- [3] European Commission (2011) White Paper Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system. <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0144:FIN:EN:PDF>. Accessed 17 December 2012
- [4] Quak H (2008) Sustainability of Urban Freight Transport. Dissertation, Erasmus University Rotterdam
- [5] Allen J, Anderson S, Browne M, Jones P (2000) A framework for considering policies to encourage sustainable urban freight traffic and goods/service flows. University of Westminster, London
- [6] Woudsma C (2001) Understanding the Movement of Goods, Not People. Urban Studies 38:2439–2455. doi: 10.1080/00420980120094605
- [7] van Rooijen T, Quak H (2010) Local impacts of a new urban consolidation centre – the case of Binnenstadservice.nl. Procedia Social and Behavioral Sciences 2: 5967–5979. doi: 10.1016/j.sbspro.2010.04.011
- [8] Dablanc L (2007) Goods transport in large European cities. Transportation Research Part A 41:280–285. doi: 10.1016/j.tra.2006.05.005
- [9] Odgen KW (1978) The Distribution of Truck Trips and Commodity Flow in Urban Areas. Transportation Research 12:131-137
- [10] Nuzzolo A, Crisalli U, Comi A (2011) A Restocking Tour Model for the Estimation of O-D Freight Vehicle in Urban Areas. Procedia Social and Behavioral Sciences 20: 140–149 doi: 10.1016/j.sbspro.2011.08.019
- [11] Marchau V, Walker W, van Duin R (2008) An adaptive approach to implementing innovative urban transport solutions. TransportPolicy 15: 405–412. doi: 10.1016/j.tranpol.2008.12.002
- [12] Berekoven L (1995) Erfolgreiches Einzelhandelsmarketing. C.H. Beck Verlag, München, p 28
- [13] Müller Hagedorn L (1995) Betriebstypen im Einzelhandel. In: Tietz B (ed) Handwörterbuch des Marketing, 2nd edn. Schäffer-Poeschel, Stuttgart, pp 243-244
- [14] Hansen U (1990) Absatz- und Beschaffungsmarketing des Einzelhandels. Vandenhoeck & Ruprecht, Göttingen, pp 269-275
- [15] Bretzke W R (2010) Logistische Netzwerke. Springer, Berlin, Heidelberg, pp 101-103
- [16] Gudehus T (2010) Logistik. Springer, Berlin, Heidelberg, pp 138-139
- [17] Liebmann H P, Zentes J, Swoboda B (2008) Handelsmanagement. Vahlen, München, p 662
- [18] Tietz B (1993) Der Handelsbetrieb. Vahlen, München, p 745