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Sustainable city logistics — Making cargo cycles viable for urban freight transport

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ABSTRACT

Urban freight and city logistics are central to the UK economy, but face a number of economic and environmental challenges. This paper contributes to a new body of research that investigates the potential of cargo cycles to make city logistics more sustainable and explores ways to encourage their diffusion. The paper makes three key contributions. First, it develops a typology of cycle logistics based on a literature review and expert interviews in order to clarify definitions and terminology. Second, it identifies perception issues, lack of awareness and regulations as major barriers to wider implementation at city level based on snap-shot case studies. Third, it suggests a sustainable city logistics framework for urban governance, logistic operations and future research, to harness the potential of using cargo cycles for sustainable urban freight transport. The paper argues that local authorities have a key role to play in creating conditions that incentivise large logistic companies such as DHL, Hermes and TNT to integrate cargo cycles into their supply chain and hence drive a long-term modal shift. The findings of the paper are of interest to policy makers, urban logistic operators, research institutions and citizens as potential customers.

1. Introduction

Cities need to identify new strategies to increase quality of life of their citizens while maintaining economic competitiveness. Over 50% of the world's population is now living in cities (Grimm et al., 2008). In Europe, around 75% of the population already lives in urban areas (European Commission, 2014). Without fundamental system changes, the trend towards urbanised living is leading to ever increasing congestion and pollution levels and a number of further challenges caused by high population density. Despite increasing challenges caused by urbanisation and densification, citizens demand liveable city centres. Therefore cities need to ensure quality of life for their citizen while maintaining access to goods and services. In this context, urban mobility plays a key role in the promotion of sustainable urban development of a city. In particular, an efficient freight transport system is required as it plays a significant role in the competitiveness of an urban area and represents an important element for the local economy regarding the employment and income that it generates (Russo & Comi, 2010).

Urban mobility accounts for 40% of all CO_2 emissions of road transport and up to 70% of other pollutants from transport (European Commission, 2015). Urban congestion is not only causing the increase in environmental pollution and energy consumption, but also increases the length of private and commercial journeys. Every year the European economy loses approximately 1% of Gross Domestic Product (GDP) due to congestion (European Commission, 2011). These facts directly relate to public health as traffic emissions are responsible for 70% of the cancerous and other dangerous substances (Silva & Ribero, 2009). As confirmed by several empirical studies urban freight vehicles account for 6–18% of total urban travel (Cambridge Semantics, 2004; Figliozzi, 2010), for 19% of energy use and 21% of CO_2 emissions (Russo & Comi, 2012; Schoemaker, Allen, Huschebek, & Monigl, 2006). Although urban freight and logistics are central to the UK economy, the sector faces several emerging economic and environmental challenges fuelled by the mega trend of rapidly growing e-commerce and rising number of diesel vans to meet demand (CILT, 2011). Sustainable city logistics solutions are required to address these problems in the city centres (Russo & Comi, 2012).

Cargo cycles are a zero emission alternative to light goods vehicles in city centres. This paper improves our understanding of how to develop cycle logistics to reduce the adverse impacts of urban goods deliveries without reducing the quality of city living. It identifies reasons why cargo cycles have to date remained a niche solution and how they might become a viable mainstream activity in the UK, drawing implications for cities in Europe.

This paper is structured as follows. Chapter 2 provides an overview on literature engaging with cycle logistics and presents key findings, leading to Chapter 3, which defines the research questions, data collection and methods. Chapter 4 sets out a typology of cycle logistics within a sustainable city logistics framework, followed by an analysis of three

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distinct UK case studies in Chapter 5. Chapter 6 discusses research and policy implications emerging from the previous sections and draws conclusions.

2. Cargo cycles as vehicles for sustainable city logistics

To date, there is a lack of structured research into the use of cargo cycles within city logistics (De Decker, 2012; Gruber, Kihm, & Lenz, 2014; Lenz & Riehle, 2013). This chapter presents the findings from a systematic literature review that summarises existing research and identifies the potential of cargo bikes in sustainable urban logistics. For academic papers and reports, searches within academic databases Science Direct (www.sciencedirect.com) and Web of Science (webofknowledge.com) were performed to find relevant literature within the field of sustainable urban freight transport addressing the use of bicycles, cargo bikes, cargo trikes and electrically assisted pedal cycles (Rowley & Slack, 2004).

As Table 2-1 shows, studies are mostly limited to the European context, and focus on identifying the market potential across the logistics sector or on specific case studies of either cities or companies. While cycle freight is being used today in many major cities, popular examples are based in Europe including in Paris, London and Brussels (Conway, Fatisson, Eickemeyer, Cheng, & Peters, 2011; Janjevic & Ndiaye, 2014). Existing studies range from making a clear distinction between cargo cycles and electrically assisted cargo cycles ("electric cargo bikes (E-CB)", "small electric vehicles (SEV)") or referring to both. Overall, studies find that the use of cargo cycles represent a viable solution for urban freight transport.

For example, Lenz and Riehle (2013) suggest that cycle freight can form around 25% of city centre commercial traffic in the medium term and that a potential market does exist. The recent outcome of the European project *Cyclelogistics* indicates an even higher potential stating that in average 51% of all motorised trips in European cities that involve transport of goods could be shifted to bikes or cargo bikes. In their quantitative analysis of operational and external costs Melo, Baptista, and Costa (2014) suggest that SEVs are a viable solution to satisfy both public and private stakeholders. An important operational

Table 2-1
Overview of key references and projects on the use of cargo cycles in sustainable city logistics.

Research subject	Authors	Content	Scope	Key findings
Small electric vehicles (SEV)	Melo et al. (2014)	Quantitative analysis	Portugal	SEVs are a viable solution to satisfy public and private stakeholders, when operational and external costs are fully accounted.
Electric cargo bikes (E-CB)	Gruber, Ehrler, and Lenz (2013); Gruber et al. (2014)	Technical potential, user requirements	Berlin, Germany	19%–48% of the mileage of courier logistics done by combustion engine vehicles could be substituted by electric cargo bikes.
Bikes for urban freight	Lenz and Riehle (2013); Riehle (2012)	Exploratory study	Europe	High potential for the food and courier, express & parcel (CEP) market. Obstacle: perception of cargo cycles as a suitable mode of transport and their acceptance with (potential) customers.
Freight tricycles for urban micro-consolidation (UMC) and last mile	Conway et al. (2011)	Comparative analysis of Paris, London, and NYC operations to identify potential for Manhattan	London, UK Paris, France New York, US	Freight can be shifted to tricycles without increasing overall costs and at the same time reducing social externalities. Public financial support for UMCs serving single- or multiple-carrier operations could be justified by traffic and environmental improvements and job creation.
Bicycle messengers Bike couriers	Maes and Vanelslander (2012)	Exploratory study	Belgium, Netherlands	Specific market for bike couriers exists. Obstacles: "chicken–egg-problem", doubts about professionalisation and linkages with logistical network.
Trends and innovation in city logistics	Taniguchi, Thompson, and Yamada (2014); Balm, Browne, Leonardi, and Quak (2014)	Trends and developing of evaluation framework to support diffusion of innovation	Diverse	Electrically assisted tricycles along with small electric vehicles acknowledged as trend and innovation in city logistics, e.g. case study in Brussels; evaluation frameworks needed and being developed for cross-city learning
City logistics, sustainable city logistics	Russo and Comi (2010, 2012);Taniguchi (2014); Taniguchi et al. (2014)	Concepts and measures for city logistics in sustainable and liveable cities	Europe, worldwide	Three elements are essential for promoting city logistics; (a) application of innovative ICT (b) change in mind-sets of logistics managers, and (c) public–private partnerships; from public utility point of view, the most important aspect is to promote a sustainable development strategy
Role of urban consolidation centres in use with electric vehicles and electric cargo cycles	Browne et al. (2011)	In depth case study of Gnewt Cargo, London	London, UK	Total distance travelled and the CO_2e emissions per parcel delivered fell by 14% and 55% as a result of this delivery system; trial successful from company's perspective in transport, environmental and financial terms and therefore decided to continue the operation.
"Ich ersetze ein auto" (i.e. "I substitute a car")	Institute of Transport Research at DLR	National Climate Initiative project funded by the German Federal Ministry for the Environment April 2012–June 2014	Germany (8 cities)	E-CB is more accepted by bike messengers than car users; transition towards use of electric cargo bikes for the"last mile" of urban deliveries is not yet complete. www.ich-ersetze-ein-auto.de
"Cyclelogistics"	FGM, AMOR, Outspoken, ECF, CTC	EU project co-funded by Intelligent Energy Europe Programme 2011–2014	Europe	In average 51% of all motorised trips in European cities that involve transport of goods could be shifted to bikes or cargo bikes. http://cyclelogistics.eu
"Pro E-bike"	Energy Institute Hrvoje Požar (project coordinator)	EU project co-funded by Intelligent Energy Europe April 2013 – March 2016	Currently 30 pilot companies in 8 European pilot cities	Programme, promoting "E - bikes", for delivery of goods and passenger transport, individual information and findings available via www.pro-e-bike.org
"Cyclelogistics Ahead"	Cycle logistics Federation	EU project co-funded by Intelligent Energy Europe Programme May 2014–April 2017	Europe	Cyclelogistics Ahead builds on the Cyclelogistics project. The main aim is to reduce energy consumption and emissions from freight transport in urban areas by triggering near zero emission logistics applications across Europe.