Assessing Stakeholders' Conflicts in Urban Logistics Networks through Analytic Hierarchy Process

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Logistical activities contribute about 10% to 30% of the total volume of traffic in urban areas (Agrebi *et al*., 2015). Such activities generate approximately 25% of CO_2, 30% of NO_x, 40% of noise due to city traffic (Lebeau *et al*., 2017). Evidence from many urban areas shows that urban logistics generates about 40% of the total logistics cost in the supply chain and causes 50% of the road accidents in the city centre (Lebeau *et al*., 2017).

Within this context, *pooling solutions* proved to be an efficient way for alleviating environmental and congestion problems in urban areas. The significant feature of this method is to implement consolidation models within city areas. In this, different organisations (e.g. shippers, carriers, customers) collaborate in the common use of logistics resources regarding materials, equipment, and human resources (Jesus *et al*., 2014). As a pivotal type of facility within such models, Urban Consolidation Centres (UCCs) have received increasing interests from both the academic community and practitioners.

An UCC is *a facility involving the transhipment of goods directed to urban areas, aiming to consolidate deliveries, and thus provide greater efficiency (and effectiveness) in the distribution process by increasing the truckload factor and decreasing the number of trucks used, which help mitigate urban congestion and air pollution* (Tario *et al*., 2011). Normally, an UCC delivery network (Figure 1) is composed of different participants such as operators, shippers, carriers, UCC administrators (Allen et al., 2012, Björklund and Johansson, 2018). Furthermore, two more kinds of stakeholders: goods suppliers and consumers are involved in this delivery system (Wang *et al*., 2015).

Physically, goods from different origins should be gathered at the UCC before they move into urban areas. After this intermediate step, goods will be sorted depending on their destination and due date; finally, goods will be allocated for final deliveries in the city centre through the usage of smaller vehicles. The key objective of UCC facilities is to achieve a higher truck loading rate, along with a lower number of utilised trucks (Nguyen *et al*., 2015).

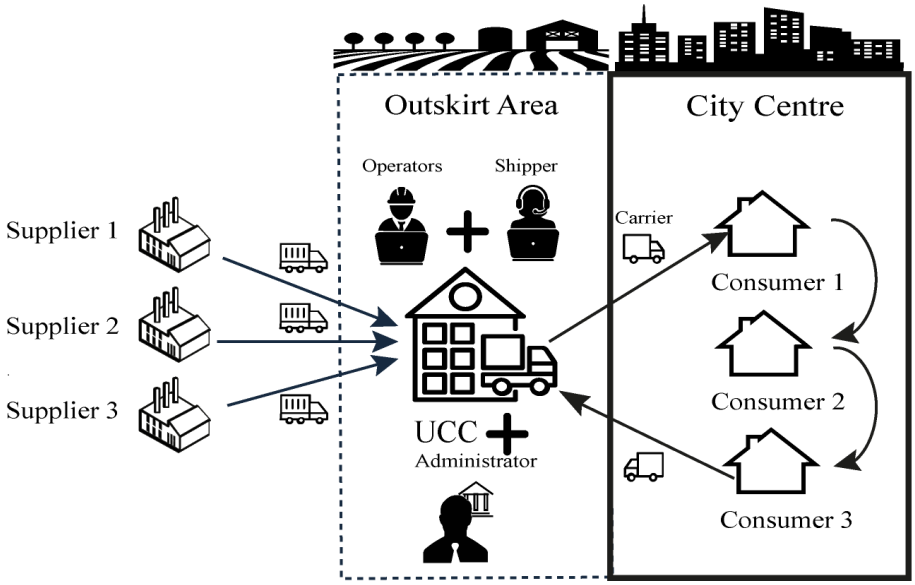

***Figure 1** - A typical UCC delivery network*

UCCs have become a popular research topic since the late 1990s; As highlighted by Lagorio *et al*. (2016) and Kin *et al*. (2017), to date UCCs effectiveness has been assessed mainly through multiple or single case studies analysing best practices and pilot projects. Most of the papers produced within this research strand concentrate on the evaluation of the environmental performance of UCCs, investigating how operating models (Finnegan *et al*., 2005), locational decisions (Lindawati and De Souza, 2017) and technological choices (Allen *et al*., 2011) affect the performance of UCCs across several environmental indicators (such as fuel consumption, gas emission, pollution).

However, in the context of sustainable urban logistics, few studies investigate the feasibility of UCCs in the multi-stakeholders environments. Especially, as the attributes of UCC's stakeholders are heterogeneous, their objectives are equally different. UCC project may result in conflicts between economic and social/environmental priorities of different stakeholders (Nordtømme et al., 2015, Tsiulin et al., 2017, Aljohani and Thompson, 2019). Such conflicts might undermine the success chances of UCC projects. In addition, there have been insufficient discussions on the heterogeneity of the various key stakeholders' preferences and on rigorous way to capture these.

This study aims to fill these gaps. A mixed-method approach (combing quantitative and qualitative methods) was employed, in order to identify the divergence between stakeholders' preferences and the reasons for such variations; such an approach was tested on four real-world UCC cases (two from Sweden and two from China).

Firstly, an analytic hierarchy process method (AHP) (Saaty, 1990) was adopted in order to identify stakeholders' objectives when joining UCC networks. This approach will combine and rielaborate economic, environmental and social indicators arising from previous research (Patier and Browne, 2010, Allen *et al*., 2011, Gonzalez-Feliu and Morana, 2014, Harrington *et al*., 2016, Gogas and Nathanail, 2017) and seek to capture the perspective of the multiple stakeholders involved in UCC systems. Table 1 shows the adopted indicators. The fundamental scale and consistency tests proposed by Saaty (2004) were utilised.

Secondly, in order to explore the variation in stakeholder preferences in the investigated cases, the degree of correlation in the rankings of the indicators was assessed using the Kendall's tau and Spearman's rho coefficients, in order to reveal potential conflicts between the different stakeholders' perspectives.

The proposed approach could help decision-makers in the context of Urban Logistics to identify and mitigate conflicts among different stakeholders when establishing new UCCs. The paper will present results from the above-mentioned four case studies, along with policy implications for setting up successful UCC initiatives in urban contexts.

Dimension	Criterion	Indicator
Economic	Operating cost	Annual operating cost
	Pricing policy	Typical delivery price
	Infrastructure usage efficiency	Infrastructure surface usage rate
	Goods handling efficiency	Goods handled per full-time equivalent employee
	Delivery efficiency	Delivery accuracy rate
	Service level	Lead time of delivery goods from UCC to its users
Environmental	Eco-vehicle equipment	Percentage of alternative vehicles
	Rational vehicle utilization	Truck loading rate
	Emission generation	Changes of travel miles in urban areas
	Effect of consolidation strategy	Reduction of delivery trips per day
Social	Public support	Public financial investment
	Workers' satisfaction	Average staff salary
	Fair labour	Workers' overtime utilisation
	Traffic volume generation	Changes of travel time in urban area
	Congestion generation	Time for kerbside parking

Table 1- *List of the Criteria and Indicators for the Evaluation of the UCC*

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