Collaborative Urban Logistics

The Synchronized Last Mile

PRESENTED AT

THINK EXECUTIVE
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COLLABORATIVE URBAN LOGISTICS – THE NEW PARADIGM

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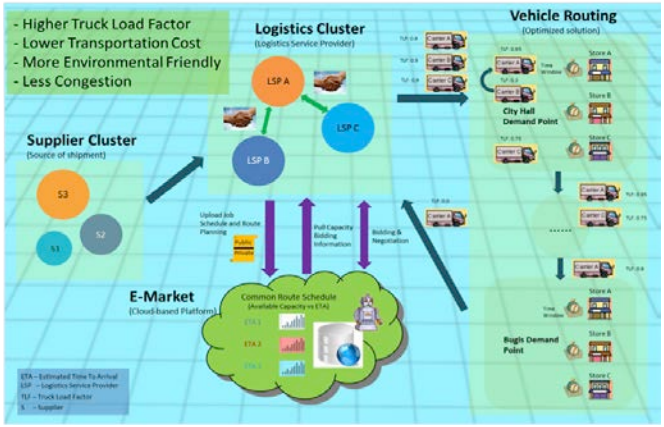
The Last Mile

The "Last Mile" (or "Last Kilometer" or "first mile" in the case of collections/returns) is a little addressed but common logistics collection/distribution problem in built-up (urban) environments. Nearer to the aggregated or single demand (or origin) point a higher capacity and up to then a relatively efficient supply chain traversing through several chain links may face significant fulfillment (last/first mile) constraints, higher social, environmental and economic costs and increased complexity in maintaining its prior designed-in economies of scale in meeting expected service levels.

The *synchronized last mile logistics* concept seeks to address several challenges that hinder reliability, cost efficiency, effective resource planning, scheduling and utilization; and increasingly, sustainability objectives. Subsequently, the meeting of service level and contractual commitments are competitively impacted with any loss of efficiency. These challenges can essentially be addressed in selected industry sectors through a better understanding of logistics structures; innovative supply chain designs and coordination of services, operations and processes coupled with concerted policies and supply chain strategies.

Challenges may be attributed to several dynamically interacting but poorly understood causes, not least of which is that the demand points (source points in B2B or reverse supply chains) are often located in highly access-restricted areas away from larger distribution centers, spread into disparate demand or supply clusters and subject to regulated access (e.g. time windows), congestion, fleet/load use limits, and dynamic interaction amongst many competing interests and services, policies and interventions.

An overview of a proposed (simplified) *synchronized last mile* concept is illustrated opposite that is a variation (enhancement) of the current practice (in single company managed supply chains). The concept includes clusters of customers, suppliers and service providers interacting through a marketplace (that could be company or industry focused). Here *Logistics Service Providers* or LSPs may receive supply chain transfer requests from manufacturer/shipper or supplier clusters, or each LSP may have its own request bank, each LSP may then upload its job schedule and route planning to the electronic marketplace which plays an intermediary role between coordinating its customers' upstream and downstream.



The e-marketplace pools the requests to generate feasible vehicle routing options for LSPs with time window constraints. The LSPs may pull capacity bidding information from the E-marketplace and either schedule self-fulfillment or collaborate with other LSPs through load consolidation, open bidding and negotiation. The generated final vehicle routing plan optimizes truckload factor and information for estimated time to arrival. Benefits such as higher truck load factor, lower transportation cost, more environmental friendly and less congestion may result.

Relevance to (Urban) Singapore

Singapore as a city-state is unique and has generally handled the *synchronized last mile* effectively but as urbanization extends across limited space, as the population increases with added demands and expectations, as e-commerce takes hold, as sustainability ranks higher in public and corporate consciousness, as costs escalate and service levels become more acute, as data proliferates and this and time become a competitive advantage and as productivity comes into focus and as city segmentation occurs; new business challenges are manifested in freight scheduling and management that need to be revisited and companies then need to seriously address the existing basis of their collaborative arrangements, resource allocation, delivery modes, patterns and asset utilization and ownership.

Secondly, Singapore provides a living laboratory for experimentation with innovative *synchronized last mile* urban concepts that could be readily translated into business practice with selected pioneering companies. The lessons learnt from this base and from the extant literature base then applied to the greater region with multiple (tiered and possibly planned) cities (with probably clustered industries) is a natural progression and an opportunity for significant visibility and knowledge transfer (and enhancement) as work in this area of the *synchronized last mile* still lags in our region but is relatively prevalent in Europe, for example.

Key Challenges

Several key challenges include:

- Exploring effective sustainable time managed solutions to freight traffic congestion
- Addressing the implicit and explicit complexity of last mile logistics and the associated system level dynamics
- Coordinating multiple parties (agents) for overall system efficiency and cost effectiveness
- Harmonizing data and dynamic analytics for real-time decision support
- Rationalizing urban freight movements in the context of urban developments
- Integrative synchronization through a public/private e-marketplace

Collaborative Logistics

The *synchronized last mile* emphasizes multi-party collaboration to extend and optimize their resource portfolios and to reinforce their market position. In the collaborative *synchronized last mile,* resources are directly connected and coordinated, and relevant data are harmonized and exchanged in order to create a common and mutually accessible plan. Manufacturers and service providers can improve operational efficiency and effectiveness and reduce costs through collaboration due to higher utilization of their less-than-truckload capacity and asset repositioning capabilities.

Corporations are exposed to a variety of challenges resulting from the future development of markets, increasing environmental requirements, new technologies, and evolution of complex supply chains, requiring the fulfillment of demanding customer promises such as tight delivery time windows in the environment of congested urban areas. The main objective of *synchronized last mile* collaborative urban logistics is for shippers, manufacturers and logistics service providers to individually and/or collectively improve their economies of scale/scope in terms of value chain efficiency (total end-to-end logistics cost), overall system productivity and effectiveness (of asset utilization and customer service levels), harmonized data analysis and environmental sustainability (minimize the overall carbon footprint) without compromising their competitive advantage.

Wikipedia on Emergence of Last Mile Concept (Illustrates its parallels to Logistics)

The **"last mile"** or **"last kilometer"** is a phrase used by the telecommunications and cable television and internet industries to refer to the final leg of the telecommunications networks delivering communications connectivity to retail customers; the part that actually reaches the customer. The word "mile" is used metaphorically; the length of the "last mile" link may be more or less than a mile. Because the last mile of a network to the user is also the first mile from the user to the world when he is sending data (such as uploading), the term "*first mile*" is sometimes used. The last mile is typically the speed "bottleneck" in communication networks; its bandwidth limits the bandwidth of data that can be delivered to the customer. The final mile links, are the most numerous and thus most expensive part of the system. As demand has escalated, particularly fueled by the widespread adoption of the Internet, the need for economical high-speed access by end-users located at millions of locations has ballooned as well. As requirements have changed, existing systems and networks, which were initially pressed into service for this purpose, have proven to be inadequate. To date, although a number of approaches have been tried and used, no single clear solution to this problem has emerged. This problem has been termed "The Last Mile Problem".

Source: Wikipedia

To address collaborative urban logistics, research has been identified in 4 key areas that aim to synchronize the last mile

1. Eco-Friendly Collaborative Last Mile Logistics

The distribution of consignments can be defined as the task of servicing a set of customers with a fleet of capacity-constrained vehicles located at single or multiple depot(s) and has been established as the Vehicle Routing Problem (VRP). The significance of solving VRP is becoming increasingly apparent not only to the organizations involved, mainly due to the escalation of the costs involved in the current world economy with soaring fuel price, inflation, but also poses significant national and international implications due to the escalation of traffic congestions and air pollutions experienced by many urban cities worldwide. Therefore, it is not surprising that there is a growing demand for planning systems capable of producing high-quality economically efficient VRP routes, which plays a central role in the intelligent optimization of sustainability distribution logistic networks.

Conventional VRP should be extended with additional objectives and constraints of environmental factors to improve the efficiency and reduce environmental impacts for last mile logistics in an urban environment.

Research should benefit:

- LSPs in planning and optimising their logistics services provided for common routes with multiple pickup and delivery points according to the schedules, which define time windows with consideration of environmental impacts;
- An LSP to do dynamic routing and scheduling for a vehicle based on real-time traffic conditions for a common route with multiple pickup and delivery points and to repair the route in response to any change of environment/traffic conditions;
- The designs of new models and algorithms for Quantification of Eco-Indicators (QEI) based on multi-factors such as relationships between vehicle types, tonnage/loading, road conditions, traffic conditions, fuel consumptions and emissions, etc. – providing for a measure of the environmental impact.

2. Multi-Party Coordination in Last Mile Logistics

The transportation and logistics sectors play important roles supporting the business activities in the cities. In fact, the last mile deliveries of goods into the city centre represent 10% of the traffic volume in an urban environment. However, in most cities, the last mile logistics is largely uncoordinated. Shippers engage different logistics service providers (LSPs) for deliveries to the retailers in the cities. This model is inefficient and unproductive, resulting in low utilisation of trucks, excessive truck movements, and higher system-wide cost and negative environmental impact

The concept of Consolidation Centres (CCs) has been proposed as a solution to address this challenge. Goods to be delivered are first consolidated in a CC before a single LSP delivers them to the individual retailers. In this case, the LSP could take advantage of the consolidation in order to arrive at a more optimal delivery plan to the city centre. The benefits include an increase in load factor, decrease in the commercial vehicular traffic, reduction in CO_2, NO_X and PM10 emissions and an increase in overall service levels

However the traditional CC has been successful only due to the facilitation and support of a governing authority. In a purely voluntary model (i.e. without facilitation and support) financially viable operation requires a high level of participation from the ecosystem of end receivers (retailers for the case of the retail sector) and LSPs.

To rely less on the governing authority (such as the city municipality), research is targeted at a market-based flexible and dynamic model focusing on collaboration across different parties on a common platform. The research departs from the traditional model in that it aims to create an environment where the consolidation centre is established as a (e-) market. Different parties and stakeholders including shippers, LSPs, carriers, retailers, and city municipalities, will all have important roles to play in determining how the last mile deliveries are then eventually executed.

Research is aimed at:

- Methodologies including algorithms and coordination mechanisms applicable in the multi-party setting under the new operating model
- Establishing an e-Market platform which would enable execution of these models

Four projects have been identified as part of this program to synchronize the last mile

3. The Last Mile Framework, Data Harmonization & Analytics

Last-mile logistics plays an important role in a supply chain. It is the final stage of delivery freight to urban customers, by meeting the timing promises. Thus last-mile logistics directly affects the satisfaction of customers and quality of delivery services. On the other hand, last-mile logistics is a very challenging stage. It deals with different issues in vehicle choice, delivery scheduling, route planning, etc., which are affected by static and dynamic factors such as customer demands, available resources, priority requirements, traffic conditions, cost changes and so on. Any of these issues could be crucial for the reputation and further development of a Logistics Services Provider (LSP). It becomes more challenging if the different geographical environment between different cities and the different requirements for different industries is also considered.

With the parallel and rapid development of IT and computer science technologies, data analytics has captured business attention with a value placed on "learning from data" more than ever before. Research should leverage on integrating, maintaining and analysing static and dynamic data from different sources, e.g., past purchase orders, historical delivery activities, current customer demands, current season, real-time traffic conditions, etc., to provide interfaces and decision support modules to Logistics Service Providers allowing them predictive capabilities and decision support in last-mile logistics.

Research is aimed at:

- A framework for last-mile urban logistics to analyse the efficiency and effectiveness of the system and framing into an Asian context last-mile logistics models.
- Visualizing the last-mile urban logistics system through “geographical analysis” as a prelude to deeper analysis and generating key evaluation criteria.
- Capturing historical and real-time data from heterogeneous data sources then providing a uniform interface over which the urban logistics’ end users may access the multiple autonomous and heterogeneous data sources eliminating data uncertainty and ambiguity.
- Holistically analyzing both historical and real-time data from heterogeneous sources using efficient and reliable data analytics algorithms.

4. Synchronized Last Mile through Multi Objective Planning

Multi-objective optimization, last mile delivery, city logistics, resource allocation, less than truckload and truckload shipping, backhaul trucking, packing and unpacking, sustainability are part of the last mile decision space.

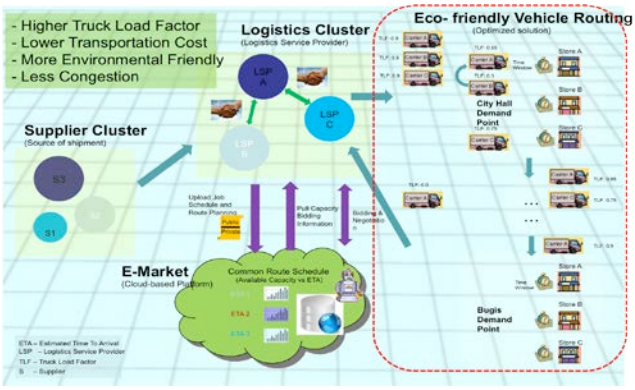
Collaborative Urban Logistics focuses on service level and contract performance analysis. Information sharing and service contract design help to enhance collaboration and coordination. However, it is also risky to share business intelligence that may compromise competitive advantage. Service level contracts have proven to be an effective lever tool to motivate logistics service providers (LSPs) to enhance their service quality through selecting a proper benefit-allotting ratio. To better serve the purpose of a collaborative logistics service system for the city level delivery, a framework to share information and a guideline for the service contract is required to ensure effective coordination and collaboration between customers, service providers, and suppliers.

Economic development and urbanization poses a myriad of challenges to urban freight delivery in relation to the negative externalities such as traffic congestion. It is thus meaningful to find solutions to minimize traffic congestion so as to increase urban freight delivery efficiency, which in turn will improve resource allocation efficiency, lower delivery time and reduce air and noise pollution through managing complex multi-objectives.

Research should:

- Help vendors and service providers adopt multi-objective planning mechanisms to improve efficiency in urban freight delivery
- Enable stakeholders to gain better visibility of the delivery performance of a service contract.
- Provide a deeper understanding leading to more robust strategies for last mile synchronization that could improve the delivery process efficiency while reducing cost in managing the inherent trade-offs in a structured manner and with the assistance of decision models.

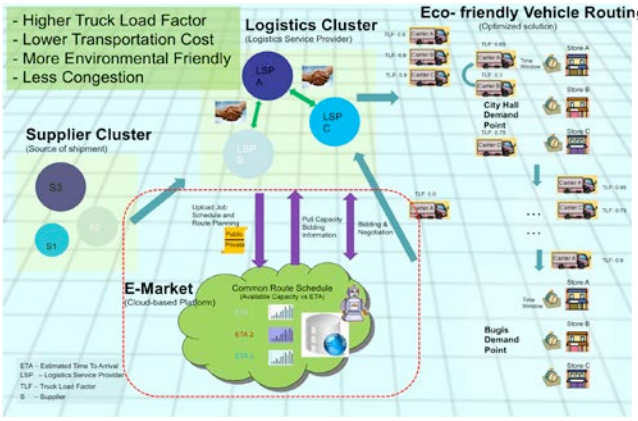
The research framework is best summarized through comprehensive problems statements supported by industry validation



Eco-Friendly Collaborative Last Mile Logistics Problem Statement:

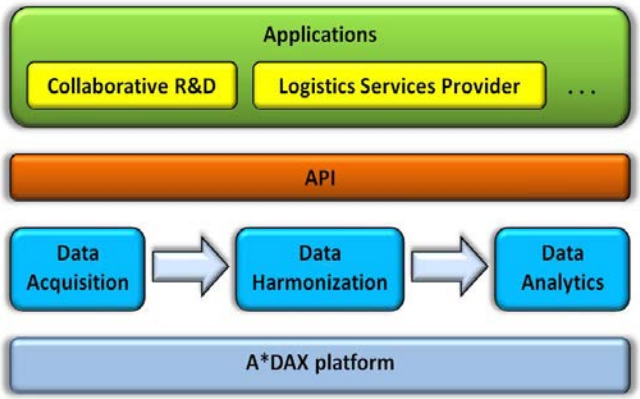
How do companies face up to the challenges and respond with innovative solutions for freight planning and scheduling for last mile logistics in urban environments. Specifically,

- How should commercial traffic servicing retailers and other business users at downtown be optimised to increase quality of urban life?
- How could the amount of heavy goods commercial delivery vehicles be managed to reduce congestion and improve air quality?



Multi-Party Coordination Problem Statement:

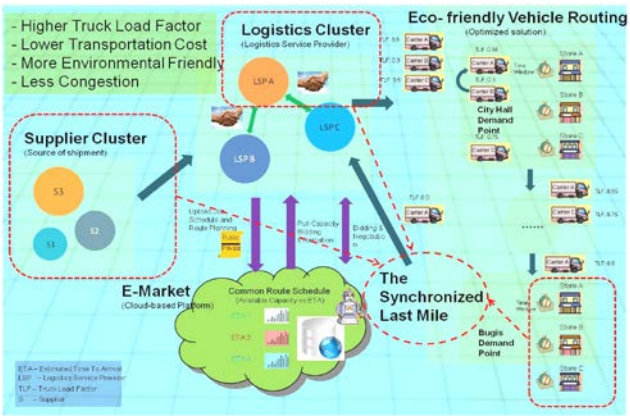
Is there a market mechanism that allows multiple shippers, LSPs, carriers and customers to collaborate across a platform to bid/negotiate on delivery jobs and coordinate timings of deliveries while respecting their individual constraints and statutory requirements of city authorities?



Data Harmonisation and Analytics Problem Statement:

Last-mile urban logistics has many structures and serves varied sectors.

- Is there a framework that best represents these in a comprehensive manner?
- Can such problems be visualised easily with geographical analysis based on data available?
- Can a unified view be presented of (real time) data residing at different sources in an unambiguous manner?
- Can this be exploited for dynamic demand forecasts that are critical for the synchronized last mile?



Synchronized Last Mile Logistics Problem Statement:

Last mile logistics is currently regarded as one of the more expensive, least efficient and most polluting sections of the entire logistics chain in an urban environment.

- Is good resource scheduling under multiple objectives and complex constraints a possibility?
- How could contracts be crafted to increase cooperation among vendors and service providers, and how to best analyse the service contract performance?
- How to simulate and understand issues in urban congestion through casual loops?

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