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Approaching delivery as a service

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Abstract

This paper explores the new logistics business model of Delivery as a Service, a concept aiming at a more efficient, fast and customer-oriented practice, linking IT solution development, urban logistics operations, supply chain efficiency and new business models. Delivery as a Service (DaaS) is defined as a service-oriented delivery and business processes in line with customer expectations and needs in the on-demand economy. The approach of this paper is an industry report based on evidence collected in multiple exploratory European projects integrating ambitious and strategic findings on Internet of Things, urban planning, consolidation centres, transport optimisation, and clean vehicle use. It contributes to a future scenario of urban logistics business models.

Keywords: New delivery concept; Urban freight trend; Business model; Software solution

1. Introduction

Future urban delivery services are driven by the tremendous growth of eCommerce and a combination of the key major trends as provided by technological developments. These are the

- Sharing economy or on-demand economy. Economic activities centred around online platforms, where independent sellers can offer goods or services to customers (Colby and Bell, 2016).
- Digitalisation and connectivity of transport and logistics, summarising connected IT services, supporting and facilitating transport and logistics operations. New enabled business models that would include data

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connectivity, analysis and prediction will enable new servicing offers such as capacity as a service or crowd sourced delivery (McKinsey, 2016).

- Autonomous vehicles and delivery vans referring to the technical level that reduce the need for the driver to directly control the vehicle. Achieving level 4 and 5, at which the system can handle all situations automatically throughout the entire trip and no driver is required anymore, would generate up to 50% of saving potentials on the Total Cost of Ownership (McKinsey, 2016).

The outcome of these developments is to revolutionize urban mobility, leading to massive structural changes in consumer habits, competition, investment, technology, and regulation. Commerce-driven business models enabled by online market-places set new requirements on how commerce is taking place, thus resulting in new forms of deliveries. New opportunities through electric and autonomous delivery vehicle and progressing digitalisation of delivery processes enable completely new form of delivery schemes challenging vehicle manufacturers, retail and logistics industry as well as cities. New business models and market offerings out of this development can be summarized as **"Delivery as a Service" (DaaS)** implying new models based on **service-oriented delivery and business processes in line with customer expectations and needs**.

This paper is to summarize and discuss key trends that will likely change urban delivery, leading to new business models as reaction on the on-demand economy and delivery processes related to new vehicles and powertrains for delivery vehicles. A new concept resulting out of these trends will be introduced named Delivery as a Service, applying the principles of "Mobility as a Service" concept. According to a new market study, the global market for MaaS is estimated to grow to >250bn USD by 2023 (Market Research Future, 2019). There is no scientific literature currently available for DaaS.

The methods used in this exploratory paper are trend analysis and literature review, analysis of ongoing European projects findings, scenario building and business strategy analysis.

The aim of this paper is to explore a new concept, provide explanations and more clarity about the definition of Delivery as a Service, or DaaS, with emphasis on the point of view of urban logistics, online retail supply chains and use of information technology.

2. Approaching future urban freight: current market trends and major concepts

Success and failure of urban freight innovations rely to a large degree on the accessibility of urban infrastructure for future vehicle concepts as well as on the urban regulation framework. To facilitate the future adoption of new solutions for digital technical infrastructure, such as 5G networks, the network capacity and access needs to be secured for any kind of future business model for delivery. The resilience of urban infrastructure systems is a key success factor for efficient, sustainable and customer-oriented service.

Approaching future urban delivery requirements by digital solutions and services is to address logistics planning and execution and traffic management optimization synchronic: Hand in hand, at the same time. Core element of such solutions are collaborative, city-wide platforms that exchange data and information and provide software service to optimize freight and traffic operations. From a logistics perspective, such platforms need to provide access to information on the status of city network and access, to route and redirect vehicles, to establish communication between freight service users and providers, to enable and facilitate matching and provide estimated time of arrival. From a traffic management perspective, generating and providing freight dedicated data analytics and forecasting are key enabler to optimize flow and infrastructure usage for freight operators in the city.

New macro logistics concepts like the Physical Internet provide a comprehensive framework combining digitalization, automation, sharing economy and modularization. Large saving potentials can be achieved by applying these principles along the supply chain.

Studies by PWC (Prümm et al., 2018) suggest cost decreases for the last mile of 51% due to the application of analytics and dynamic forecasting, automation of vehicles, electric powertrains and less administrative efforts.

The on-demand economy is not only increasing its market share through the internet and technology progress and breakthroughs, making online purchase easier and faster; it also influences a different habit of consumers, and especially their increasing expectation of a very fast delivery service, in some cases below 2 hours (Dablanc et al., 2017; Dablanc et al., 2018).

In this regard, a market survey of European executives show that price remain a decisive purchase criteria, and delivery speed is not generating an increased willingness to pay by the consumer (McKinsey, 2016) (Figure 1).

Table 1: Criterion for evaluating delivery options, in percentage of respondents

Criteria	%
Price	54
Delivery location (home/office)	26
Speed and reliability	20

Source: McKinsey, 2016.

Table 2: Willingness to pay more than 1 Euro for same day delivery

Country	%
US	20
Germany	10
China	19

Source: McKinsey, 2016.

Despite new developments, in Europe, the sectors transport and warehousing are not considered to have a high degree of digitization and are lagging behind the more digitized sectors of advance manufacturing, finance and media (Bughin et al., 2016) (Figure 1).

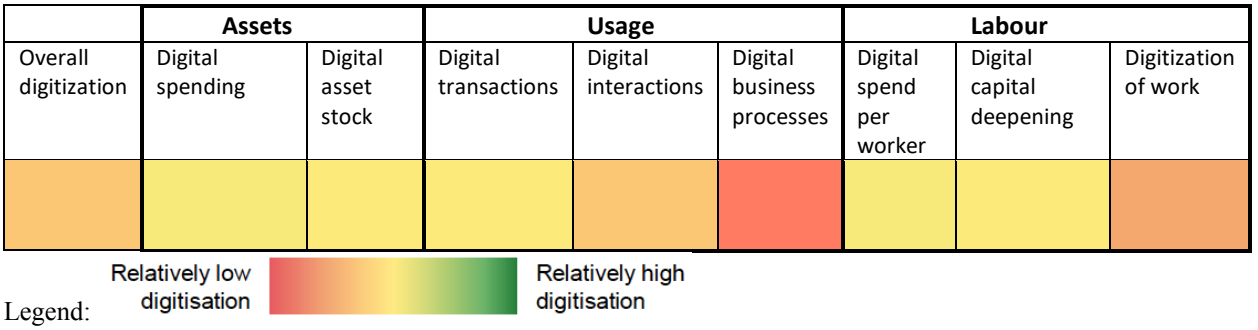

Fig. 1: Digitization index of transportation and warehousing economy in 2015
Source: Bughin et al., 2016.

Core of the Physical Internet and advanced digitization in logistics, transportation and warehousing is a high level of connectivity and interoperability of the supply chain stakeholders to exchange data and information and to harmonize and optimize processes and activities, co-operatively.

On the manufacturing side, visionary vehicle designs like the Daimler Vision Van incorporate these trends into a comprehensive design study for future trucks: electric powertrain within level 4 to 5 autonomous vehicles, cargo loaded automatically using modular load units, drones for the last mile delivery.

For example, prototypical last mile robots developed within the Germany research initiative Lieferbot-E show the technical feasibility of these approaches. In this project, the fleet consists of autonomous, electrically driven delivery vehicles, as well as parcel post box at the buildings of the district. Shipments can be automatically and quietly transferred between the vehicle and the parcel post box via the storage technology installed on the vehicle. Packages of different sizes are delivered, and recyclables collected. The vehicles are manually loaded by the driver of the delivery service outside the urban area. The unloading of recycling materials is automated at defined collection containers that are easily accessible for disposal vehicles (Hopfgarten and Sun, 2019).

Concluding, freight planning will be an integral part of an overall transport management system in which infrastructure and delivery capacity as well as customer needs and requirements will be matched.

3. Future freight operation

3.1. Last Mile fleet

Many logistics service providers currently modify and extent their urban fleet. DHL (2019) employs a fleet from electric cubicycle, electric delivery scooters and vans in different sizes, capacity and adapted operation ranges. Clearly, an adaptation to the city is needed depending on the geography as well as on delivery area and zone. Common to these vehicles is: They stay in the area of the delivery since their operation range is limited. For example, the newest electric Streetscooter XL, comparable to a "classic" DHL delivery van, has a capacity of 200 parcels and a battery capacity of 70 km (DHL, 2019). Such vehicle profile works well in the context of recurring volumes in known areas and follows the classical depot to home concept.

Most future delivery studies address the introduction of autonomous vehicles in order to achieve a significant cost saving due to lowering or avoiding personnel costs for the driver. Prototypical approaches on level 4 to 5 vehicles are available: Automated, remote controlled delivery trucks from Einride are tested in Sweden, Starship delivery robots are tested in various cities. Still, this is technology in progress, but might have potential to be used to transport between hubs or to serve as a liner service along fixed routes and stops.

With progressing autonomous driving, a parallel development needs to go hand in hand, as the modularization of cargo and loading units are enabling an automation of handover processes. Within postal services, modular box systems are successfully in place since decades. With modular box standards, the load factor in trucks can be improved. Furthermore, a modular load unit standard allows to automate sorting and transshipment processes and technology. However, beside the postal standards, similar standards for other industry branches are missing. The MODULUSHCA project provided a recommendation for a common box standard for the FMCG market (Ballot et al, 2015). The further market uptake is presently under development at GS1, the international body for standards for business communication, and might have further beneficial impact for urban delivery.

3.2. Future demand planning

Urban logistics is increasingly impacted by the on-demand economy and faces a shift from push (vendor- and logistics driven) to pull (customer-driven) concepts. Consequently, logistics service providers (LSPs) must design more flexible and efficient logistics systems to stay profitable and competitive in such a fast-changing environment. For retailers, fast and on-time delivery will significantly impact customer demand and loyalty and current last-mile options are considered not to be sustainable with respect to the triple bottom line. In the near future, the needs outlined above will increase further due to acceleration of e-commerce, changing mobility patterns, and societal changes such as ageing of societies and ongoing urbanization. Market research by PWC (Nowak et al, 2018) clearly indicates that online shoppers ask for a flexible and timely delivery, in line with own delivery preferences. Following the study, customer would be willing to pay average 2,40 Euro for synchronized delivery at accurate time windows. Key finding of the study is that 66% of all inquired buyers want to determine time, day and location of the delivery by themselves.

On-demand and responsive delivery is generally defined by the short time availability of cargo. Looking at the details, it could mean that cargo is taken from the store and delivered to the customer, or there are micro storage or depots that can fulfil the request. Obviously, the on-demand economy will rely on logistics structures of the Physical Internet, in which supply chain and transport infrastructure are interlocked (Montreuil et al, 2013).

3.3. Freight matching

The market development study by PWC (Nowak et al, 2018) suggests that trucking and logistics will be one ecosystem of autonomous vehicles directed by digitized supply chain. Highest savings can be achieved on the last mile where analytics and dynamic forecasting will make delivering to home more efficient. While transhipment from larger to smaller trucks are still needed, as well as drivers, the costs savings due to a better freight matching could be 51%.

Freight dispatching of fleets positioned throughout the city, which can be summoned and redirected, might be a business model for OEM.

4. Delivery as a service

”Delivery as a Service” (DaaS) is a new approach complementary to the “Mobility as Service” (MaaS) approach, integrating various forms of transport services into a single mobility service accessible on demand. Transferring the passenger centered mobility concept onto freight defines “DaaS” as different forms of logistics services incorporating shared connected and low emission transport operations. DaaS systems allow:

- To meet customer requirements responsively;
- To introduce new business models;
- To use an open and neutral service providing new ways to manage and implement various transport options.

DaaS is focused on collaborative logistics solutions that may be convenient and more sustainable, while contributing to the achievements of societal and environmental goals: the promotion and up-scaling of sustainable and environmentally friendly logistics solutions is the core objective.

Logistics systems must be flexible and responsive in real time in order to cope with the requirements of the on demand economy. Relevant characteristics of DaaS driven urban logistics solutions are:

- The shared use of transport systems within the city using public and private infrastructure;
- Matching of mobility activities with freight operations such as combining parcel pick up with travel to work;
- A complete change of goods transport related traffic flows from freight gravity points to decentral urban hubs.

4.1. Community

Research on horizontal and shippers’ collaboration (NEXTRUST, CO3) has led to the set-up of a number of freight related communities, aiming to pool and optimize freight demand and processes, collaboratively.

A successful example for a collaboration was surveyed within the CLUSTERS2.0 project (2019), in which the airport of Brussels is collaborating with the freight ground handlers together with the logistics service providers, to better manage the slots at the freight terminals. A business community has been established using a common app to book time slots for the pick-up and delivery at air terminals. This approach led to significant time savings for the logistics service providers and ground handling, improving the parking situation of waiting trucks, at the same time. A community approach shows parallel with collaboration in urban freight on the operation of urban consolidation centre.

Current DaaS concepts for urban planning, integrating sustainable logistics in a wider context of urban regeneration, were presented at the neighbourhood level (Figure 2). In Europe, there is a wider development of Sustainable Urban Mobility Plans (SUMP), including Sustainable Urban Logistics Plans (SULP) (Fossheim, Andersen, 2017). In Barcelona, another concept at the neighbourhood level is named “Superblock”. In Regio-Emilia in Italy, a similar planning concept of “urban island” integrates slow speed and local traffic into a SUMP. These concepts would benefit greatly from DaaS actions.

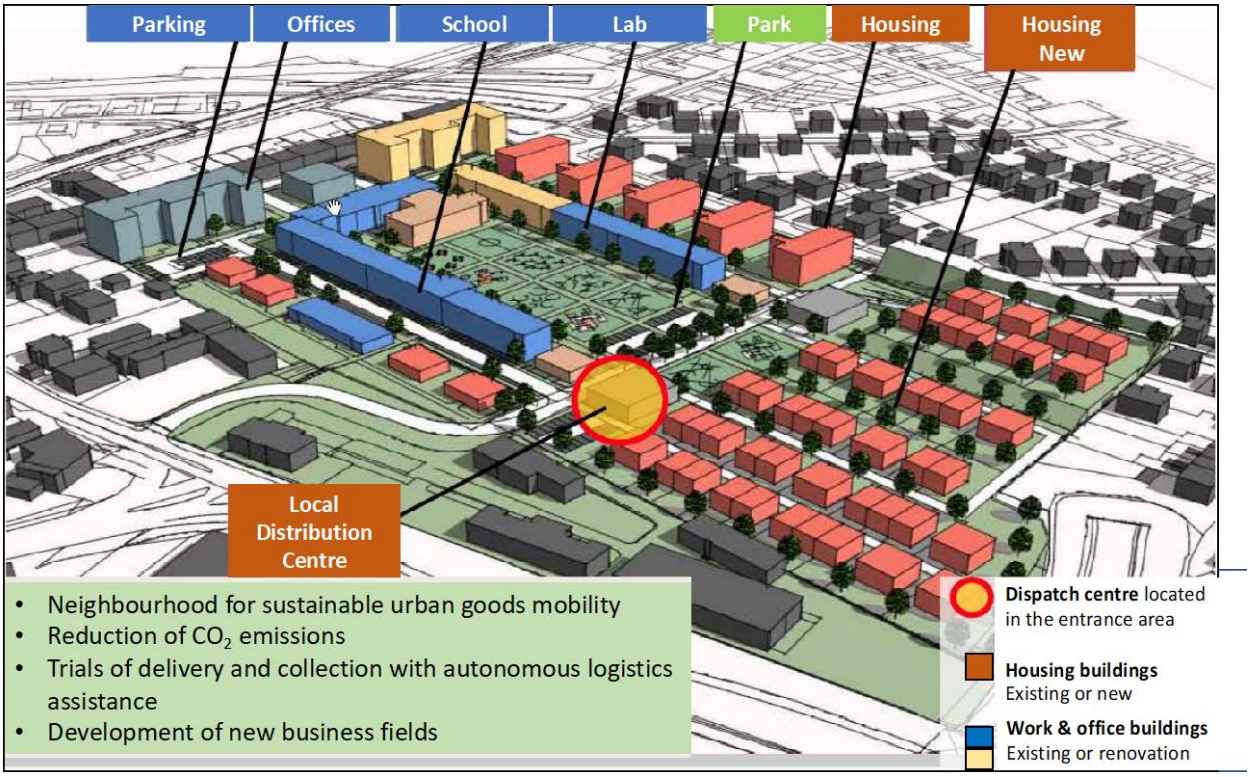

Fig. 2: Planning and sustainable mobility concept including an on-demand DaaS at the level of a neighbourhood

BESTUFS (2005) already stated that UCC solutions only seem to be successful if the imposing organisation is able to control or strongly influence all the players. Establishing a business model around a city community of key urban freight stakeholders is the key driver for a DaaS. The business model would need to be scalable, reaching a critical mass of volumes of users using this community to manage and control their freight streams and revenue, achieving cost and process improvements for last mile operations.

4.2. Neutrality

DaaS seek to co-ordinate stock, optimize freight operations and bundle flows across partly competing partners. Neutrality and openness are key requisites of the service needs to be guaranteed. CLUSTERS 2.0 (2019) identified the role of community manager being a trusted and nominated manager of the community interests seeking fair and efficient flow of community processes and future activities.

The Volkswagen study (Frische et al, 2019) developed 4 future scenarios on how urban freight can be organized:

- Logistics public service: a municipal operator operates inner city deliveries for parcels and groceries, using fleets adapted for urban environments
- Logistics Cooperative: logistics service providers are co-operating in order to bundle flows and capacity, while cities provide supportive framework and a decentral space for logistics
- Logistics Lab: In this scenario, the city is an innovation playground, in which new business and planning ideas will be developed, tested and implemented
- Tunnel Logistics: all inner-city deliveries will be made via underground infrastructure

While in the logistics public service scenario the city itself would take over the role of the market neutral operator,

within the co-operative scenario clearly an external neutral operator is needed. For the innovation scenario, a research-driven promoter and facilitator would be a matching profile, while for the Tunnel scenario an infrastructure manager would be needed.

In order to cope with market approaches, city-driven or co-operation driven communities would be the preferred option. A central element of these community-based approaches is neutrality and openness of the provider. This means parcels and consignments from all logistics service providers need to be stored and delivered. This immediately raises the question on the business model and the viability of such services. There are similar best practices in place that could be used as reference. The successful Heathrow freight consolidation centre operated commercially "so successful as any new retailer uses the consolidation centre as a condition of contract" (BESTUFS 2007). Transferring this concept towards a community approach would be the success criteria to scale up this concept.

4.3. Connectivity

DaaS would require a high level of connectivity. Within the AEOLIX project (2019), a prototypical realization of a collaborative connectivity platform has been realized. Based on the universal connectivity platform establishing information exchange with customer IT systems and software services. Specific dashboards provide users specific views on status and progress of operations. Establishing such platforms would require the interplay of services and connectivity and communication platforms. Enabling a many to many connectivity cloud solution is offering best opportunities. The following functionalities and specifications are currently observed on the market of connected cloud services:

- Cloud applications (like PTV Map&Guide or RouteOptimiser); these are freight applications as software products, which include a route planning application for freight transport. In such IT solutions, truck specific attributes are used to profile truck operations and to schedule delivery processes.
- Apps (like Drive&Arrive), to provide parties concerned on the status of delivery
- Basic services like routing, geocoding and routing to calculate scenarios for planning and optimization
- Dashboards, like planner, driver or user apps
- From a traffic management side, data analytics and forecasting can make use of vehicle movement data
- Optimization scenario can be triggered for vehicle detections and context information

4.4. Freight Matching

DaaS in a dynamic, automated application is considered a "Dial-a-Ride-Problem" (DARP), and it consists mainly answering the question: how to define the best route between pick-up and delivery within time windows. Key aspect within DARP is to keep and fulfil the customer requirements while minimizing time, distance and the fleet capacity. We consider a scenario in which a vehicle positioned in a local area of a city can be summoned with a transport request to a city hub or to a consumer to collect a parcel or shipment. Alternatively, a vehicle that is already on the road gets redirected to a loading address in order to pick goods. Trips can be pooled and consolidated.

Software products, as given for Mobility as a Service, apply similar solutions for real-time dispatching of passenger and freight transport. The core component is a dispatching algorithm with a newly developed algorithm for fast and scalable requests. For route finding, many software products such as the PTV software X-Route2 and X-DIMA, are available. For the real time arrival calculation, the so-called Estimated Time of Arrival (ETA), new software products such as PTV Drive & Arrive, can be used.

High potential suggests the integration of logistics planning of logistics service providers with traffic management. Given the growing pressure to increase the sustainability of both urban freight transport and traffic systems, the unlocking of the potential to optimize freight fleets within the city under an overall regime is of great importance.

The potential of this integration goes well beyond passing congestion information to route planners. Promising advances include customization of travel time predictions, traffic management measures for specific user groups and dynamic planning and routing. This leads to more efficient routing decisions, less traffic and less emissions. Also, carriers or hubs can provide traffic managers with traffic status or routing information to improve their predictions or inform infrastructure changes. Benefits are found in the wider traffic system as well in the private logistics operations.

5. Conclusion

DaaS seems to be a visionary but realistic scenario, compatible with the most recent developments in city-logistics and Sustainable Urban Logistics Plan, linking the business world with the urban policy makers and the research community. Relying on co-operation, there are parallels with earlier approaches such as co-operative distribution or urban consolidation centres. IT solutions providing trusted environments and connectivity can be a game changer and pave the way to success for DaaS. The big tech companies however have not identified logistics as its core competence and might not provide a global, universal platform for urban freight. This gap can be filled by cities and OEMs that might identify the city goods mobility service as future business model.

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