

The role of crowdshipping in sustainable city logistics

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Abstract

In recent years, city logistics has gained more and more importance. Cities are faced with numerous challenges, such as the increase in the number of inhabitants, the increase in exhaust gas emissions, the increase in noise in urban areas, traffic congestion, etc. In terms of logistics, there has been an increase in delivery vehicles in traffic, a lack of parking spaces, infrastructure problems such as traffic bottlenecks, locating and building distribution centers, etc. The growth of e-commerce drastically affects the number of delivery vehicles and the effects they bring. A potential solution, based on the principles of sustainable development, which would have an impact on the city's economy and environment in the future, is crowdshipping. This solution represents the integration of passenger and freight traffic. Using the strategy of the sharing economy, crowdshipping is based on an already existing transport network in which passengers, in addition to traveling for their own needs, get an additional role as needed, which is most often reflected in the form of transport, i.e. the delivery of cargo/small goods. The advantages of this model are great both for ordinary citizens and for companies whose shipments/cargo are transported every day, as well as for courier operators.

Keywords: City logistics, sustainability, crowd shipping, shared resources.

1 Introduction

The production cycle in postal traffic takes place through four interdependent technological phases that consist of characteristic work operations, namely: reception, processing, transportation, and delivery. According to [1] the costs of different technological phases when handling letters and packages differ. In both cases, delivery costs have the largest share, with the fact that they make up 50% when transferring letters, while, on the other hand, transport costs are significantly higher when transferring packages.

Last mile delivery, also known as final mile delivery or final mile logistics refers to the transportation of goods from the warehouse or distribution center to the final destination - the end user. Last mile logistics is affected by numerous variables - the customer's location in relation to the warehouse or distribution center, the number of deliveries along the carrier's route, traffic in

transit, and user availability. The service provider needs to coordinate delivery deadlines, but also suffers the consequences of discrepancies in order tracking or routing errors that affect process inefficiency and lack of transparency. Customer experience - satisfaction, lack of satisfaction or dissatisfaction with the service provided, can easily build or damage the reputation of the seller, but also of courier companies. The focus is on last mile logistics as this is in many cases a key differentiator for businesses. Because consumers can easily switch where they want to order from, e-commerce businesses and their supply chain partners must provide exceptional service to gain market share and build brand loyalty. It's about customer convenience. And customer convenience can be driven by many dimensions, such as different delivery speeds and locations, customer-defined delivery times, return options and packaging. Last mile logistics, as part of the last technological phase in the transmission of shipments, is undergoing certain transformational

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processes that will shape the future of the industry and define new user requirements.

According to various sources [2]–[6], important trends within the concept of the last mile are:

- sustainability - companies in every business segment give priority to sustainable solutions and implement more environmentally friendly solutions,
- the share of bulky, bulky shipments in the total number of shipments (furniture, household appliances...) is increasing,
- delivery by autonomous vehicles and trucks, drone and robotic delivery,
- modernization and development of delivery management platforms in terms of transparency and traceability,
- quick fulfillment of orders and formation of urban warehouses in order to get closer to the end user,
- delivery times change, as does the frequency,
- analysis of large postal data with the aim of increasing efficiency and reducing costs,
- the trend of reducing the Outsourcing concept and increasing the share of Insourcing in last mile logistics
- Hybrid Fleet Management Systems – scaling the size of the fleet in accordance with changes in demand (greater flexibility and affordability than the traditional model)
- drivers become traders as well
- gig economy and crowdsourcing labor market is characterized by the prevalence of short-term contracts or freelance jobs as opposed to permanent jobs.

These changes imply not only extreme speed, such as Amazon's 90-minute delivery, but also more customized services with added value, such as defining a specific time moment/interval in which the user is available and adapting to his habits and desires.

So we have a user that will drive shipping, upstream supply chain, and even manufacturing (prosumer). Each shipment chooses its own path through the supply chain and through various delivery options to best meet the needs of the customer.

With the rise of e-commerce [7], consumer preferences for last-mile delivery have become increasingly important.

Crowdshipping is an emerging trend that allows businesses to partner with regional residents to make last mile deliveries. Crowdshipping can be a solution to high shipping costs because it utilizes the unused capacity of private and public vehicles that are already on the transportation network.

2 Crowdshipping as part of the sharing economy

The sharing economy represents a new paradigm that changes the existing consumer society into a more transparent, inclusive and responsible system. The essence of this model is a system of access instead of ownership of resources and is present in numerous segments of the economy and society (transportation, services, education, entrepreneurship, real estate, trade, finance, information technology).

The concept of the sharing economy based on access to goods/services versus ownership can be applied as a new business model of both postal operators through various forms of infrastructure sharing, but also by organizing partnerships in the area of shared delivery - crowdshipping delivery. [8].

Like on-demand shared transportation services, such as ride-hailing or car-sharing, crowd-shipping can introduce innovation in the traditional parcel and shipping industry. The platforms offer a more flexible service at a lower cost than traditional shipping services where are the main advantages: low delivery cost, flexibility, and eco-friendly service, but there are also disadvantages: trust issues, privacy concerns, and service quality.

Crowdshipping is a subset of the larger “crowdsourcing” movement. Essentially, crowdsourcing involves the use of technology by a large group of people with a specific goal. Retailers by partnering with a crowdshipper, can turn their vast networks of physical stores into distribution hubs for online purchases.

3 Application of the concept crowdshipping

By searching the literature for the term crowdshipping, one can find several related terms that describe this phenomenon - “crowd delivery,” “crowd logistics,” “crowd-shipping,” “crowd-sourced delivery,” “crowd-sourced logistic,” and “crowd-sourced shipping.”

The basic idea of the concept is to hire a large number of people who will become deliverymen on a voluntary basis, and who are connected through digital platforms where there is an immediate supply and demand relationship between the participants. Deliveries do not necessarily have to be professionals, but people willing to, for a certain compensation, and moving online for their own needs, become temporary deliverers of shipments (goods). Also, there are models where people make supplementary movements in order to earn additional income because they have an excess of the necessary resources - time, will or space to deliver shipments or, sometimes, also for voluntary purposes [9]. Courier activation can also be done through bidding – the request becomes visible on the platform system and all registered couriers within a specified geographic range can begin communicating with the customer and bidding. The bidding is related to pick-up arrangements such as flexibility or timing, and does not include shipment pricing which is determined by the platform using a size and distance-based formula [10].

That this concept is close and acceptable to users is also evidenced by the results of a survey [11] conducted in the USA for potential users and employees in crowdshipping. About 80% of respondents in their dataset were willing to work as CS driver-partners. This statistic could have a significant impact on logistics carriers and on society as a whole.

Crowd-shipping system is complex, but also integrated, dynamic and sustainable. This concept promises social, economic, and environmental benefits, while at the same time, it raises questions related to concerns about trust, safety and security. Crowdshipping affects the transport system through possible changes in the share of different types of traffic in the total movement, from where the potential social impact - for health or the environment - can be determined. In this way, the unused logistical capacities of road users, but also public transport users and cyclists

are used. Crowdshipping has the potential to give consumers access to a wider range of products, as well as a more flexible, personalized service that is faster and more affordable than traditional. This specific labor market includes local travelers or long-distance travelers who, by performing this service, can compensate for travel costs, but also a large number of employees who have this part-time job, so a careful examination of the employee structure is necessary in order to be able to plan resources in advance. Also, there are indications that crowdshipping may promote wider community cohesion by fostering social ties [12].

Study [13] is the first analysis of crowdshipping users' motivations, it investigates the differences between crowdshipping users and non-users. The study found that crowdshipping is most prevalent among young people, men and permanent employees, in urban regions and at medium distances. Also, among crowdshipping users there is a significant number of those who have a developed sense of community and care for the environment. Users who express concerns and reservations about accessibility and trust are less likely to be crowdshipping users.

The analyzes presented in the study [14] are based on real market data across the United States and prioritize socio-demographic and built-environment characteristics. Given the socioeconomic characteristics of the population, the supply of casual crowdshipping drivers is unevenly distributed across geographies, with higher percentages of African-Americans, lower-wage workers, and families with two or more vehicles, while decreasing in geographies with higher population density and employment. However, it accumulates in geographic areas with greater accessibility to destinations and regional diversity of jobs. The current research, however, highlights that the availability of crowd-resources is a function of not only shipping characteristics, but also the socioeconomic and built environment characteristics of both the trip origin and the trip destination.

The crowdshipping concept is expected to create significant opportunities for sustainable urban freight by harnessing the untapped resources of individuals. On the other hand, the transfer of logistics jobs to individuals is seen as a major disruption in the organization of existing businesses. logistics models, so it is important to explore the disruptive impact and feasibility of such business models. Studies, such as [15], for

the sake of uniformity, assume that all shipments are identical and can be carried by all deliverers, regardless of their type of transport. In practice, delivery people may travel by bicycle or public transport, which could create limitations for the delivery of large and heavy parcels. Therefore, it is recommended that future research include both characteristics of shipments - weight and volume, as well as different transport models.

A comprehensive study [16] identified contradictory findings - increasing profits with long-distance delivery, while at the same time, short-distance delivery in densely populated areas may be more profitable. Implementing the service along with passenger transportation, consolidating multiple deliveries per route, and transshipment between couriers are among the potential strategies to effectively increase delivery distances and expand the service beyond just short deliveries within congested urban areas.

„Urban India – Z“ - crowdshipping application may be used for both B2C and C2C services. The empirical results [16] show that social interaction and trust are strongly and positively correlated with Generation Z participants in crowdshipping services, while monetary reward on trust has significant negative correlation. The interaction at the urban centers shows that the people are eager to work but are not informed and technology-wise poorly equipped for the job [17].

Different aspects of activity patterns and travel behavior will be impacted by crowdshipping. As a result of this system, requesters will have opportunities to enroll in new activities as some of the constraints will be removed from their daily schedule (e.g., by transferring their activities, requesters will no longer need to drive to a supermarket for grocery shopping and may spend more time with family). Similarly, carriers' participation in the crowdshipping platform can modify their activity itinerary, mode choice, trip companionship, and even the quality of their life [18].

With the application of smart logistics such as Artificial intelligence, route selection, driver recommendations, and information delivery for both drivers and senders, will be generated automatically and take a relatively short time. That's why crowd shipping needs to be integrated with smart logistics. However, there are still many things that need to be considered in the implementation of crowd shipping: shipping

insurance, item size, driver incentives, misuse of personal information, and cultural issues [19].

4 Crowdshipping concept models

Within the application of this relatively new concept, there are various models. In the next part of the work, some of them will be presented, which could serve as an idea for implementation in countries where the concept has not been applied.

A microhub is a local package transshipment facility similar to the automated parcel station (APS). APS is an automated storage that allows customers to drop off and pick up packages. Package collection from APS is made possible typically by entering a mobile phone number and the access code. For ease of access, APS' are typically located at shopping centers, transit stations, gas stations, etc. As part of the Civitas Citylab project, in Amsterdam in 2018. tested a system of city center microhubs [20] in combination with freight bikes, which has led to a reduction in delivery van stops and other negative effects. Seven microhubs, carefully selected from existing PostNL stations in the City of Amsterdam are served by 50-60 freight bikes, accounting for a reduction of around 2000 van stops. By employing occasional couriers as crowdshippers for pickup and delivery services between end customers and microhubs, It could also consolidate package pickup and dropoff trips. By promoting active modes of first and last mile delivery (e.g., by bicycle or by walking), this new urban delivery paradigm of microhubs with crowdshipping would further reduce delivery costs, peak hour congestion in urban areas and emissions. Performance was evaluated by comparing with the current state-of-the practice hub-and-spoke paradigm (e.g., FedEx, UPS, USPS), in which all packages must be collected and shipped to a sorting center (hub) to be sorted before being shipped out to their respective final receivers. Participants in the transfer of shipments can use different types of traffic, and each type of traffic and the means of transport associated with it provide different carrying capacities. Also, a relay system can be organized between participants, which achieves greater flexibility in the service.

Under the concept of resource sharing, some European cities as well as Seattle in the US are encouraging shared lockers as part of their urban

sustainability policies. There are also initiatives to open the possibility of using parcel machines of postal operators for third parties (USPS - GoPost, bpost - Cubee) even up to the level of the national network. Depending on the characteristics of the shipment, the cabinet may include a temperature-controlled section optimized for food or medicine. Finally, the shared parcel locker could complement the microhub model: same-day deliveries could be done from microhubs to parcel lockers (and parcels collected from lockers transported to microhubs for delivery). In Berlin, Amsterdam, and Paris, the national posts are involved in the test of a Coordination and Optimization Technologies (COTs) - powered microhub model. This model [21] involves trucking parcels to small depots — microhubs — from which hyper-local urban delivery (within a radius of about one mile) is done faster and cleaner by carriers on foot or by small electric vehicles such as cargo bikes. While logistics operators currently use their own delivery workforces in these early experiments, they could use a mix of their own and crowdsourced deliverers in the future. The main benefit of COTs which combine algorithms, data analytics, Internet of Things, machine learning, and platform technologies is that technology complements the fixed postal network with additional and scalable infrastructure and resources, making it relatively easy and cost-efficient to manage and coordinate.

The paper [22] provides the operational flexibility of mobile depots, and the relative cost efficiency of crowd-shipping for package delivery in urban areas. The two-tier delivery model optimally selects mobile depot locations in advance of full information about the availability of crowd-shippers, and then assigns to available crowd-shippers the final leg of the shipment to the customer. Scenarios are simulated for a City of Toronto case study, in which demand is a function of population density and crowd-shipper availability is a function of observed commuting patterns.

According to the findings of a study [23] conducted in London, it was determined that delivery vehicles in the inner city spend about 60% of the total time on the route parked on the curb. The authors introduce the term 'portering' as a new concept where delivery people meet with porters and hand over part of the consignment to them, usually in light mobile carts, while they continue their route to visit remote locations or

transport heavier consignments by vehicle, which can achieve savings of 89% on some routes and about 69% in total time. Another possible scenario is that the delivery person leaves the part of the shipments in predefined acceptance points from where the carriers can pick them up. This concept would imply a larger amount of shipments than in the first case because the facility covers a larger area.

The main idea of paper [24] is to use in-store customers to deliver an online order on their way home from the store. They are spare time and spare vehicle capacity. Authors have focused on employing in-store customers to deliver online orders. The in-store availability time reflects the time that the customers are doing this shopping, after they go home or deliver one or more online orders on the way home. One of the main limitations of the approach is that it assumes knowledge about the next destination of in-store customers, based on which their routes are constructed. In practice, some in-store customers may be reluctant to reveal their destinations.

As part of the pilot research carried out in the study [25], the local population in a city in Finland delivered and picked up read books (PiggyBaggy) within the concept of crowdshipping in cooperation with the public library. In addition to the ecological and economic contributions and the analysis of the possible wider application of the concept to the delivery of food for elderly users in this way, it has a significant role in creating social cohesion and social value. Also, libraries could become a nucleus for developing and testing new ways of collaborative consumption, for instance, extending their lending portfolio from books and music titles to other consumer goods like exercise devices, tools, or other equipment required rarely.

At a time when the traditional role of the post office is changing due to the development of digital alternatives, social media offer a new way of connecting with customers, the development of new products that unite the physical and digital worlds and reveal new opportunities for the positioning of postal services - they are not only present, but relevant and vital in the new communication environment [26]. Social commerce tends to be viewed as a transaction that's facilitated by social networks. Postal tracking technology also could be viewed as social engagement - it's talking to customers and letting them know what's going on.

Crowd workers typically prefer to remain anonymous; however, being anonymous may easily cause one to be or become unreliable. By using friends and acquaintances chosen by individuals with a certain level of friendship from within their social networks, one alleviates the privacy concerns at least in part; and a customer will always be able to opt out of crowdsourced delivery. This way of functioning leads to the development of social capital (social benefits resulting from inclusion in social networks and organizations such as clubs, religious communities, non-profit associations, and unions, as well as various forms of cooperation and connection with neighbors and family). The concept involves users sharing their location on social networks to help each other by delivering ordered goods that are on a planned route. A study [27] conducted in the city of Alexandria, Virginia examines the potential of using contacts on social networks, but also points out possible problems: what is the level of friendship/acquaintance for users to feel comfortable in this process, and are people ready and under what conditions should they minimally deviate from their route in order to pick up the shipment. In this way, the problem of "not-at-home syndrome" and the "ping-pong" effect (when agreed-upon delivery times are not met by customers) which, in real conditions, require expensive subsequent delivery, would be alleviated. The paper considered the delivery of one friend once, but the authors believe that in the future there is also the possibility that more people can deliver to one person or that there is a relay system.

4.1 Crowdsourcing and public transport

In addition to their own means of transport, delivery people in crowdsourcing can also use public transport, and several such studies are presented below.

In [28], the idea of applying the crowdsourcing concept in combination with the use of public urban transport, where shipments are delivered through a regular flow of passengers while reducing the number of delivery vehicles entering central city districts, is presented. The test took place in the Danish capital and northern Jutland over a period of two months, in which 28 automated parcel lockers (APL) were installed at public transport stations/stops. The applicability of the concept is illustrated by examining the attitude of the participants in the pilot project - the

experience with the service was positively evaluated with a high degree of acceptance. One of the important criteria is the location of APL. Participants were more willing to take a package on the way back than on the way out. This could potentially be a challenge, as the solution would optimally utilize commuters from the periphery on their way to work or school in the central parts of the city. Also, outbound trips may be easier to fit into existing routines because inbound trips have time constraints associated with work hours or layovers, so the extra time to find APLs or access the application produces additional stress or dissatisfaction that can lead to giving up on execution services. An important precondition for the implementation of this service is the good functioning of the Public Transport System - reliability and predictability.

Exploring motives for the use crowdsourcing authors in [29] indicate that a crowdsourcing solution might increase chances of success by catering to altruistically and socially oriented values, by framing participation environmentally towards users rather than focusing on economic incentives in its design and communication. This principle includes the experience of positive emotions caused by living in accordance with one's own and others' ideals - "doing good" as well as being part of a social group that shares these values.

The research [30] refers to the city of Rome and considers an environmental-friendly crowdsourcing based on the use of the mass transit network of the city, where customers/crowdsourcers pick-up/drop-off goods in automated parcel lockers located either inside the transit stations or in their surroundings. The potential of APLs is connected with the metro network, thus proposing a more environmentally friendly crowdsourcing with respect to a fully based rubber-tired crowdsourcing.

The implementation case study refers to the city of Rome, Italy, and addresses its metro lines, thus understanding and quantifying the effects of this freight transport strategy for e-commerce in an urban context [31]. The highest potential impact of this innovative service is linked to e-commerce and food/groceries-related deliveries. The idea is to involve people using public transport which, on average, imposes lower environmental and congestion costs on society. The authors investigated what percentage of commuters would be willing to work as a

crowdshippers with different defined services. The results, although preliminary, are encouraging - there is high confidence in the success of the service (about 48% of the sample) and the estimated number of potential crowdshippers for the case of Rome is actually higher than the potential demand.

5 New business models

Q-commerce ('quick commerce') - sometimes used interchangeably with 'on-demand delivery' and 'e-grocery' - is e-commerce in a new, faster form. Q-commerce, refers to a new trend in e-commerce that emphasizes fast, on-demand delivery of goods and services. Q-commerce is similar to traditional e-commerce in that it allows consumers to order products online, but it differs in terms of speed and convenience. With q-commerce, customers can typically receive their orders within hours or even minutes, rather than waiting days for traditional delivery services. The q-commerce is nothing new. It has been used in the takeaway food industry for many years. Q-commerce is a must for brands that target professionals and older people. Speed is guaranteed by the existence of hyper-local micro-fulfilment centers ('dark stores') dotted around densely populated stretches of cities and positioned in close proximity to those making orders. These organizations monitor customer behavior patterns and adjust inventory to guarantee the availability of the requested products. In addition, an additional benefit is the ease of use and 24/7 availability.

Certain operators, e.g. Amazon, develop trust-based services such as In-home delivery, In-car delivery, In-garage and In-fridge delivery. The service is connected to a lock (Key by Amazon) and a security system and allows the delivery person, using a one-time code, to enter the user's house and leave the package while he can later view the complete video of the delivery or track it in real-time. Walmart has gone one step further – it wants to reach consumers' kitchens and refrigerators. Similar to Amazon's home access model, it equips workers with body cameras to ease consumer concerns about strangers entering their homes. Additionally, Walmart is pledging to ensure employees have been on the job for at least 12 months before being allowed into customers' homes and will include brief biographies of each worker in its delivery app to personalize the experience and start building trusting customers

of this service. In the future, work is expected on regulations that could regulate complicated relationships between users and service providers, because providing privacy in this way is very susceptible to abuse, while on the part of the service provider, it reduces delivery failure to zero [32].

Universal Postal Union (UPU) defines postal social services [33] as services that are explicitly designed to provide a direct benefit to society, that are provided regularly, reliably and are widely accessible. Some social services generate direct income for the post office, others achieve goals defined through a socially responsible business strategy, and improve visibility and brand recognition, while certain postal social services are designed to support governments in implementing their social obligations and policies. UPU has defined six important areas within which there are around 40 services that different postal administrations already offer: health and well-being, education, social cohesion, participation and inclusion, access to government services, waste, recycling, energy and utilities, and data and technology. For countries that are just entering the process of providing social services, it is important to look at the experiences of other operators because future demand may vary depending on the geographic region or the end user.

6 Conclusion

The paper presents the concept of crowdshipping as part of the sharing economy. Through a review of scientific and professional literature, various forms that have already been implemented in urban areas are shown, as well as research into the basic advantages and challenges related to the motives and trust of all interested parties, the effects on society, and the environment, and the efficiency and effectiveness of these models. This sustainable concept combines environmental, economic and social aspects. The postal sector needs to promote a culture of adapting services to the changing needs of society, while embracing new technology, and implementing innovations to remain relevant to the public and focused on the future.

Future research in this area could aim to apply this concept in suburban and rural areas with a special emphasis on the realization of a human and inclusive service that provides access to

social resources, institutions, and processes and focuses on vulnerable individuals.

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