On-Demand Services in Transportation and Mobility – A Structured Literature Review

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Abstract: This article aims to examine the application opportunities of on-demand services in the transportation and mobility sector. As these personalized, demand-driven services are gaining prominence in more and more areas, their dissemination and operation should be given a deeper understanding and overview, thus a structured literature review is being conducted in the study to examine these adaptive service processes.

There is a great variety in these service types and characteristics, such as on-demand transportation services, demand-responsive transport, dial-a-ride transit, flexible mobility on demand, and many others. Because of this, a systematic approach is strongly justified, as there is a great need for a comprehensive summary, in order to learn more about the nature and operating model of these services.

1. INTRODUCTION

On-demand services and products refer to the way how the demand for these commodities is fulfilled. This concept requires remarkable flexibility because upon its appearance, the demand has to be satisfied immediately; on the other hand, prior that, for instance placing a particular order, commodities are not really available. This means “real time” fulfilment in a demand-uncertain environment (Qiu et al, 2021). Such method ensures flexibility and speed with large capacity or resource reserves to meet the sometimes quite fluctuating demand, that can occasionally explain by immediate responding to fluctuating price levels (Du et al, 2019). Although these systems are not economic, neither efficient without the tight integration along the phases of the value-chain and certainly, some level of predictability or delay may be anticipated, for example state-ensured stabilizing control over transportation (Yan et al, 2019).

The great resource and capacity demand on the input side is compensated by the negligible or zero demand for storekeeping, because the final product is immediately taken, sold, delivered or people get served through the inherently given demand. It is extremely advantageous if the final products are perishable or turn obsolete very rapidly (short product life cycle), or when the range of alternative solutions are wide through fierce competition. Naturally, no need for store-keeping release additional resources from logistics (physical storage), administration (inventory control), manpower (security), overheads and so on.

The flexibility, promptness and up-to-date being are regarded as the most beneficial and innovative features of the concept of on-demand. As a consequence, the term is overused (intentionally) by marketing departments or by the media. The phrase is used in cases whereas the fulfillment is obviously done so. Such trivial instances are hair-cut, pizza delivery or cash machine
usage. This is also a way to emphasize uniqueness of the products or services respectively, even if this is not always the case. An example for the latter is when an item is assembled of pieces of distinctive materials or coloration, which pieces are made upon the demand, but not the entire item. The supposedly attached positive connotation of the on-demand product and services is questionable in the mentioned cases, so they are usually not labelled as on-demand services professionally.

2. BACKGROUND OF THE CONCEPT

The concept was elaborated for the first time by Ariyasu (2005) in the book “On Demand Logistics”. On-demand services, including logistics, means direct responding to each individual requests in a way that the upstream and downstream side of the value chain is very tightly integrated (Wang et al, 2008). In practice, that reflects to the special idea of delivering from the manufacturer directly to the door of the customer, covering the problematic last miles, detailed later in this study. As a novelty, such integration can facilitate the optimization of the entire value chain comprehensively to achieve smoother operation as a result. To that end, understanding commercial logistics is essential.

Enterprises with minimal logistic activities are especially in need of optimization, plus they are, by size, more flexible. According to Ariyasu’s theory (2005), after standardization, visualization – clearing related information out – can they optimize, link, strip, so as to develop their network of logistics, although it may require special software and hardware back-up. Logistic systems as any other activity, can be also explained through input, conversion and output (Figure 1); the problem occurs usually at the connection points, hence social interactions (e. g. room for misinterpretations and misunderstanding, especially in a culturally diverse environment) and dependency. On the other hand, one can realize the conflict of interests among some elements too, e. g. finance and pollution from a superior perspective (Dong-lai, 2004).

If the actors are not varying per stage or element, so when the system is integrated into “one hand”, then the conflict is easier to solute. On a sublevel for example, when transportation entails water transport, railway, their features are different and not standard. In a micro-, administrative realm, when more actors are involved, different forms, institutions, channels, communication methods complicate the process. Optimization is desired to deal with the described phenomena and according to Ariyasu (2005), on-demand logistics can be a solution respectively.
The core sentiment is that one should imagine logistical structures as a wide network with nodes suitable for manipulation instead of a “flat” line. Nodes are allocation points (warehouses, airports, etc.), and their links (physical routes and flow of information) form areas they serve. To arrange the network the most effectively, all the elements must be in the authority of one actor and the most vital function is the positioning of the nodes (Ge et al, 2010). Upon globalization, global value chains, the necessity of rethinking the traditional logistic systems became inevitable.

Apart from the purely economic viewpoints of the network’s arrangement, flow of information, market-orientation, local tastes, invisible barriers across countries turned to be more affectual. The local market, the individual customers’ demand itself is more important nowadays than the upstream side’s capabilities, hence global competition. In other words, it is called external-orientation or “demand chain management” by Madhani (2013). The phrases “on-demand” or “end-to-end” refer to the whole logistic system’s complete (both upstream and downstream) and real-time alignment to the single demands (Ariyasu, 2005). Such a mission touches upon several disciplines from management to technology, from political interests to administrative pitfalls throughout the entire value chain from development to after-sale services.

3. DEVELOPMENT OF ON-DEMAND DELIVERY

Due to the spread of digital technologies, recently enormously boosted by the pandemic, commercial activities have developed, including e-commerce (Kovács, Vinkóczi, 2020). However, the evolution of on-demand services began with a particular problem, which had always been present in history: delivery. Delivery had no primal importance for companies in the past, they focused on demand, product range, production costs and therefore customers might have to wait for days or week to receive any product they ordered. Logically, improving delivery systems means additional expenses for the enterprise in question; in the meanwhile, it was only a second viewpoint for the clients, especially because the product variety available upon order is usually much wider than those available promptly in physical stores (Buics, Süle, 2022).

This preliminary stage had evolved over a long period, but the twist happened relative suddenly with the establishment of Amazon in the United States. Amazon delivers products only in a couple of days, which is a revolutionary speed (Amazon Prime). The consumer perceives only the timespan between the placement of the order and the reception of the item, but all the while, a plenty of complex logistical problems must be solved, among them one of the most prominent issue is the so-called last mile delivery. Although, according to others, companies (Walmart) and researchers (Jindal et al, 2021), the focus on delivery is not always the best strategy.

It is relatively easy to deliver products in large amount across continents, overseas to specific countries and populous large cities. Driven by scale, this is cost effective as well, but the problems appear at the level of the individual settlements, whereas the whole process slows down and delivery routes diverges greatly, and the products have to be sorted. Contrarily to the cost-effective, mass overseas delivery, from airport to airport, harbor to harbor, at this level, small amounts must be carried more or less individually to several destinations and clients. According to Hong and his co-authors (2019), the last-mile is accountable for half of the total shipment expenditure. The latter the phase of the delivery is, the costlier it is and attention (administration) is required by the task. Timing is also crucial, it entails communication with the customer too, apart from the B2B (manufacturer and delivery service provider) and internal communication. Additionally, transportation on land is more times expensive than water
transportation (Si-Log Network, 2019). Based on the substantially different nature of the various delivery stages, it is not rare that more service providers cooperate to manage the assignment, specialized for certain methodologies.

The new concept of on-demand delivery was invented by Amazon Prime to hedge the described problem. In 2005, Amazon started to offered two-day shipping without additional charges for subscribed customers (Bensinger, 2015). As a direct impact, the subscription fees, which were already paid prior the placement of an order, partially ensured financial coverage for the operation required only at a latter moment. In short, there was some revenue before the request and expense. In order to raise money as much as possible before the appearance of direct costs, subscription has to be promoted. This culminated in a new approach in strategy. The company incorporated numerous additional services into Prime, such as movie streaming and special offers for instance. As a consequence, in the long-run, subscription revenue continuously increased. There was also another paradigmatic shift on the demand side related to consumer culture, expectations and attitudes (Yan et al, 2019).

With the accelerated speed of information spreading, technological innovations, changes in fashion and taste, the value and perception of time changed worldwide. The waiting started to be regarded as a burden, a particular kind of cost on the behalf of the buyer. This attitude was firstly indicated by the popularity of the Prime subscription, namely that clients pay in advance in order to be served sooner, with other words, in exchange for a shorter waiting time. Long-term subscription also reflected on loyalty, therefore the durability of this new approach of consumption. The consumer base of services with longer fulfillment time started to shrink, despite their historical embeddedness and cheaper being. Vázquez-Martínez and his coauthors (2021) discussed in detail Covid's impact on consumers’ behavior; among other viewpoints, they highlighted the perception of safety and current availability of resources from consumers’ behavioral changes, but the researchers found evidence on expense cutting too.

In a purely technological realm, in the past, people went to stores, purchased albums, books, etc. while nowadays, they are more inclined to purchase them online, even if they do not receive a physical product. The compensation for that is the immediate “shipping”, flexibility and safety (Vázquez-Martínez et al, 2021) regarding the moment of purchase. This shift was largely fueled by Apple. The mentioned companies gained an invaluable strategic advantage: they are able to inform about, keep up with and respond to the changing customer demand almost immediately.

As individual tastes vary distinctively, personalization has become more relevant too. The dealing between individuals is more frequent nowadays than decades before, which was supported again by technological advancement and representative enterprises. In this respect, taxi services and recently Uber should be commemorated. Such services entail communication between individuals, especially in the case of Uber. On the other hand, taxi cabs are typical examples of on-demand services, however the payment is realized only after fulfillment. But it also highlights the importance of time, flexibility and unique needs over cost from the perspective of the client, certainly before the appearance of the virus; afterwards, the situation has changed, and the price become relevant again, but only in terms of leisure activities or “luxurious” commodities (Vázquez-Martínez et al, 2021).

The importance and utility of personalization and individual connection was recognized also by Amazon, what pioneered in this paradigmatic shift. Amazon Flex adopted the same methodol-
ogy as Uber, namely, that a person takes a package, that is meant to be delivered to a spot in his close surrounding, not to a remote place. This “delivery person” is not necessarily a full-time employee, but someone who would like to gather a little money in exchange for a small effort. This led to significant resource saving obviously if the spread of the relevant information is effectively solved.

What is a reasonable argument against shopping via ordering is that the experience is absent from the process. While shopping in a book or electronics store or in a boutique is somehow joyful, daily food purchasing for example is hardly that. Realizing that fact, several retail stores launched their own home delivery service. Although, their success and popularity are not relying on personalization, quite the contrary, on standardization and unambiguity. This way, large, mass-scale companies serve their customers with time-sparing, convenience and flexibility on-demand too (Bartucz et al, 2021).

In today’s competitive and specialized world, people devote less and less time to functional activities such as traveling, shopping or cooking, hence the upheaval of remote working, online ordering or spread of delivery as an option even in traditional restaurants. There is a demand, that the time used to be consumed by such “obligations”, should rather be devoted to our private (entertainment) or professional (livelihood) lives. This is also a deep, paradigmatic change, which is unimaginable without a sufficient level of technological advancement and its coverage, that features the 21st century.

On-demand delivery systems aim to fulfill these new streams of desires through convenience, flexibility accompanied with wide accessibility. Therefore, this business model was invented to remedy the last mile problem, which is a logistical, economic issue, and at the same time, resonates with a profound social change, culminates in commercial and individual benefits as well. Although, brick-and-mortar shops are unlikely to disappear in the foreseeable future at least, however their prospects significantly differ by industry. They need to reposition themselves and increase their value addition in accordance with the evolving consumer desires, particularly concentrating on services more in the future (Sheth, 2021).

The introduced trend is also motivated and supported by the growing amount of investments into companies, which are dealing with any type of on-demand services. And the investments have been presenting impressive yields, that reinforce the whole tendency and generate growth. As companies evolve themselves, they are enabled to offer more and more services – cooperating with more manufacturers or distributors – and to cover larger geographical areas and increase their capacities both in terms of computer capacities and labor force (Nextbrain.com, 2020).

4. MOBILITY ON DEMAND

Mobility on Demand (MOD) is built both on the traditional means of public transportation as well as on private carriers, both enterprises and individuals. However, in the case of the latter, the sharing of their travel routes as an offer is usually done via a company’s website, which serves as a pool but not as an actual actor in the process. MOD, as its name suggests, concentrates on the traveler, its preferences, therefore their evident satisfaction too and not on the supply side (Bartucz et al, 2021a). Thus, the efficiency of the whole action is more crucial, because the client is a more influential factor than it used to be in the past. The mobility is pulled by demand and not determined by the suppliers’ decisions (Bartucz et al, 2021b).
The combination of the mobility services reinforces competition and ensures great flexibility in filling gaps (idle times) in any transportation procedure (Alonso-Gonzales et al., 2020). Or on the other side, the last mile problem is also much easier to bridge, however it may require a bit of planning, depending on the recipient person of the package. It must be enabled by the available technology that is supposed to be sufficiently expanded. It is a further form of pressure on the relevant service providers. In terms of punctuality, another benefit of flexibility is evident when more means of public transportation are aligned while travelling. If the schedule is not upheld by one actor, the whole process can collapse, if alternative solutions are not at hand. A developed and spread technological background can enhance planning possibilities for the passengers and the exposure to delays for instance, can be accounted or diminished. It could be traced back to channel connection between nodes as discussed above (Ge et al., 2010).

Despite the benefit of the individual customer, there are positive externalities apart from the purely commercial aspects. The flexibility and available information about the supply side allow the whole system to align to and fulfil the demand as best as possible, meaning that there are less likely to be empty seats, wasted trips and so on, coming from the higher occupancy-ratio in general. As a consequence, less energy is required for transportation that leads to less CO2 emission, congestion, noise and vehicles required. As a positive externality, overall contamination, which is a crucial viewpoint in urban areas, is likely to decrease substantially. Although, contradictory results were also published recently by Erhardt et al., (2019).

Mobility as a service (MAAS) and mobility on demand have a similar meaning in core, but they are not identical. Both involve different transportation methods, but MOD offers higher flexibility through integrating, sharing and connecting a wider network of options, considering up-to-date information on the supply side, e.g. driver of a shared car and its occupancy or halt request or its absence on shuttles (Buics, Süle, 2022).

The new paradigm of transportation was supported by technology; however, the social vein behind may be more important. Convenience, cost, idle time, number of connections, total time and maybe further factors too, depending on the personal tastes, have an economic value for the individual. In today’s accelerated world, it is even more so. These attributes are not always in correlation with monetary terms, therefore even with shrinking budgets (spent on public transportation from governmental side,) a better result may be achieved if the mentioned aspects’ impacts are carefully analyzed per target groups, per vehicles or per location. Some argue that the coverage and accessibility of the relevant information networks is what should be funded in the first place because the rest is rather contingent on the potential passengers’ demands. The change in preferences includes that people are less likely to have their car and drive, especially in densely populated urban areas, and to relieve themselves from the attached financial burdens and efforts. As found by Kuhninhof (2017), in a market (Qian, Soopramanien, 2014), car sales grow up initially than gradually slow down. Environmental agendas enhance this tendency too.

The modernization of the transportation infrastructure is nowadays reflecting on the soft technological background from the viewpoint of the on-demand mobility. The physical side is of proportionately smaller relevance, which leads to the fact that (public) investments should target other areas. These areas, deriving from the skyrocketing prices of construction materials (van Sante, 2021), can have a large impact even from smaller input. For instance, vehicles should be tracked by GPS to enable more efficient planning. Real-time methodologies are of crucial importance, while the interface applied or the service provider are secondary (Brusse, 2020).
Although, location sharing raises privacy matters, which are not subject to this study. But stemming from industry forecasts (Verified Market Research, 2021) and the business sphere’s pilot projects to develop their position in the market (technological improvements, integrated platforms – Verhoef et al, 2015 – including several types of vehicles), on-demand mobility is gaining ground in transportation at the expense of the traditional and rigid “supply-driven” forms.

5. ON-DEMAND DELIVERY IN THE PRESENT

E-commerce was gaining enormous momentum in the past two years, which was fueled by the pandemic, but even further, the tendency was evident (Totolo & Bajjal, 2020). In particular, the author of the study put its first online order in 2019, while throughout 2020, around ten online orders were put. More importantly, e-commerce has increased its share at the expense of traditional, brick-and-mortar retailers. Acknowledging that, they had been setting up their own online platforms too (Kim & Park, 2005). This possibility significantly impacts overall customer satisfaction (Napolitano, 2013). Nowadays, providing an online, “click-and-mortar” alternative became a requirement of retailer competitiveness and survival (businessinsider.com, 2016). This necessity must be met with delivery companies as well, which, as mentioned several times in this work, had to find a solution for the last mile problem. Although, in case of a local grocery store, we can simplify it in a way that there are only last miles to manage.

On-demand delivery is the new instrument for meeting this demand and bringing their products to the customer at the desired spot and time. As described previously, Amazon Prime was the vanguard of this approach. Later, DHL outsourced that specific last-mile to the buyers by introducing the drop-off points. Additionally, the employees were occasionally asked in Walmart to deliver parcels, if the customers’ home is nearby their own or can be touched upon while they (employees) travel home after work (Bhattarai, 2017).

The system of dropping-off points did not surpass customer satisfaction, in fact, they proved to be beneficial and more convenient for both parties sometimes. Buyers with hectic, unpredictable daily schedules do not have to worry of missing the delivery, especially when he or she is living in a single-occupant flat. The last-mile problem is solved this way too (as in small cities setting a precise time for delivery is not possible, but only a more hours long range of time and just in specific periods of weekdays, the author of the study prefers pick-up points over home-delivery). Pick-up points have been adopted by several delivery companies or enabled others to provide online ordering (Jing, 2014). However, this process raises the question of the accumulation of inventory expenditures but they are either minimal or zero (Hong et al, 2019). It can be zero, if the pick-up point is ensured by an affiliate company for example. Another widely applied methodology is when the pick-up point is established in a grocery store or supermarket, whereas the visit of a customer has a potential chance of an additional casual purchase.

The task, in this case, is to find the most suitable point for installing the pick-up point, in accordance with its location, and delivery routes and time to it, while maintaining customer satisfaction. Although it is a popular method, it is unlikely that door-to-door deliveries would be squeezed out of the market any time soon, especially during the pandemic, when free movements are to certain extent restricted and some people thrive to avoid crowded places (Vázquez-Martínez et al, 2021).

This model usually involves a third party, plus the customer itself as explained above. Optimizing this model is more complicated than the door-to-door alternative. The next factors are to
be considered (Hong et al., 2019): available pick-up points offered to the customer (which is in correlation with its home, workplace, size of the settlement, etc.), the cost and time of delivering to this point by the company, its capacity and additional features (opening hours of malls, for example), preferred period for taking over the commodity (customer). Perishable goods for instance impose additional aspects to consider (freshness e.g. – Neghabadi et al., 2016).

A new, hybrid method for the described approach is “on-demand last mile delivery service”. This approach grants companies an even shorter response time than in the former case. This utilizes crowdsourcing and outsider (temporary) delivery personnel, who could either deliver to the pick-up point or to an individual spot, which is a greatly flexible method, in fact, it may lead to higher customer satisfaction occasionally (Esper et al., 2003). However, this allocation model is very problematic for companies (e.g. Amazon, DHL) to manage effectively and reliably (Traveling Salesman Problem with Time windows; Voccia et al., 2013).

6. CONCLUSION

In a summary, optimizing the location, the number of the delivery centers and routes in the light of several additional factors extracted from a real-time delivery, is a challenge to face in the on-demand logistics industry. The issue aroused upon the discovery that the last-mile can be delegated to the customer without a disproportionately great sacrifice of satisfaction. As the spot and time of delivery became flexible, a range of options opened up among which the most optimal has to be found in order to minimize costs among other possible goals. The impact of each individual factor is also remarkable when making such a strategic decision. However, as demand continues to grow, aided by the continuous development of digitalization, these challenges have to be addressed by companies in order to operate successfully on the market.

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