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On the drivers of demand for innovative freight transportation services

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Keywords: Freight transportation demand, Logistics services, Logistics integration, Transportation strategy, Transportation flexibility

Abstract: Contemporary innovations in freight transportation and logistics are instrumental in achieving more integrated, efficient, and sustainable services in the global market. While much attention is going to how contemporary innovations, including technology-enabled and management innovations, change the supply of services, little work is done on depicting their changing relationship with freight transportation demand. We present findings from a comprehensive study among Global Fortune 500 companies aimed at understanding what drives the demand for modern transportation services. We investigate the importance of three key service attributes that are growing in importance, i.e., operational control of transport mode, service flexibility and ancillary value-added services. We measure the influence of contextual factors on the choice of service, including supply chain strategy, demand volatility, internal flexibility and industry type. This leads to recommendations for shippers on how they can adjust their supply chains in the future to benefit from new freight services. Our findings also stress the need for the logistics industry to adopt modern service choice approaches.

Managerial relevance statement: This paper is practically relevant for managers of three main stakeholders of global logistics system: (i) customers of freight transportation (shipper companies such as BMW and Zara), (ii) suppliers of freight transportation (LSPs such as UPS and DSV), and the system-level agents that these customers and suppliers are operating within it (government, or industry organizations). We provide guidelines for managers of the shipper firms to align their transportation strategy with their supply chain strategy and seek innovative transportation services based on underlying complexities of their supply chain. We recommend managers of logistics service providers to design innovative transportation services by

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considering emerging service attributes and contextual factors that determine their shipper clients' demand. We advise policymakers in governmental authorities to pave the way for logistics service providers for developing innovative transportation services. We have provided a dedicated section for practical implications which includes particular recommendations for each group of managers.

1. Introduction

Many logistics innovations aim to reduce the fragmentation of the landscape of services and improve integrity of worldwide logistics ([12]). If services within the supply chain can co-operate and connect better, costs can be reduced through economies of scale, and door-to-door services can be improved ([12],[29]). To this end, many technological and organizational developments in logistics and transportation are ongoing (i.e., smart logistics, digital transformation, synchromodality, Physical Internet, Blockchain technology and so on) [1]. Also, outstanding success stories about well-performed collaborations and partnerships between global logistics service providers (LSPs)[1] and international shipper firms are reported (e.g., [2],[3],[4]). In order to implement the logistics integration worldwide, LSPs are considered as the central players since more than 70% of companies in the USA, Western Europe and Asia Pacific have outsourced their transportation and logistics functions to the LSPs ([5],[6]). In order for LSPs to implement worldwide integration in logistics, they need to match (and synchronize) their supply of freight services with shippers' demand [7]. This requires LSPs to manage the whole demand chain since demand chain management has a

[1] Throughout this paper whenever we use a Logistics service provider (LSP) we mean a company that offers a collection of logistics services including transportation, forwarding, warehousing, customs brokerage, cross-docking, distribution of goods, return management, logistics management services, etc. In real-world practice it could include 3rd/4th Party Logistics (3PL/4PL), and Integrated Logistics Provider (ILP).

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broader scope compared to supply chain management because the former emphasizes understanding customer demand, as well as improving organizational ability in product and service development to better meet market needs [51], [52]. To this end, LSPs need a good understanding of dynamics and contextual factors of global freight demand to be able to provide better freight services that create demand-supply integration [8]. This requires LSPs to adapt their business strategies toward a more demand-driven rather than supply-based logistics system [9].

Moving to a demand-driven logistics system necessitates a deep understanding of freight demand by three main stakeholders of global logistics system, i.e., customers of freight transportation (shipper companies such as BMW and Zara), suppliers of freight transportation (LSPs such as UPS and DSV) and the system-level agents and infrastructure that these customers and suppliers are operating within them (public transport infrastructure, government, and industry organizations). Regarding shippers, they need to understand how their transportation strategy impacts logistics services that they receive from LSPs. Transportation as the connector of nodes in the shippers' supply chain network plays a fundamental role in delivering right goods to right consumers at the right time. Thus, requesting proper logistics services from LSPs directly impacts their success in satisfying customers and business goals. When it comes to LSPs, having a deep understanding of their customers' needs and desires directly impacts their service package design, supply and capacity planning and overall revenue generation, in particular, for highly competitive markets. LSPs need to understand different market segments and future dynamics in these markets to be able to make right strategic decisions for future developments that match their supply of services with future demand [8]. Finally, regarding global logistics system, governmental authorities

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play a central role in making log-term strategic decisions in establishing and developing public transport infrastructure [33]. Well-developed public transport infrastructure is a key driver of economic growth and regional development [33] and has a direct impact on reducing urban congestion, providing reliable delivery windows, decreasing logistics costs, reducing emissions, improving safety, accessibility, sustainable mobility and urbanism [34], and improving competitiveness of cities and regions [35]. Therefore, A well-developed public transport infrastructure effectively paves the way for LSPs to make a synchronized demand-supply integration worldwide, i.e. via collaboration with their shippers, other LSPs, and governmental authorities. This will ultimately result in achieving global sustainability goals for logistics.

The subject of freight demand has been investigated from the 1970s, mostly in the context of transportation mode choice studies. Much research has been conducted on relative pricing of different modes and how to improve service levels in various business contexts [10]. A recent review by [11] identified transportation safety and security, service frequency, transportation cost, transit time, service reliability and service flexibility as the common components of a logistics service that influence modal choice decisions of shipper supply chains. Future demand models need to be adapted in several directions to allow to assess the impacts of logistics innovations on freight transport flows [12]. In particular, we need to move from mode choice to *service* choice in freight transportation. Various new innovations in freight transportation require us to adopt such a service choice approach. For example, in Europe, synchromodal transportation[2] was introduced by the industry as a service concept, to move away

[2] Synchromodal transportation can be explained as ‘synchronized intermodality’ which has added two distinguishing features to intermodal transportation: flexible (adaptive) mode choice and decision-making based on real-time information (see further details in [8] and [12]).

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from a modal focus in service selection to a focus on service attributes i.e., lead time, service cost, service reliability, service flexibility and so on, by using a pool of all different transportation modes, switching between them in real time, and making real-time resource allocation to different demand orders [8].

As a result of the above, also the role of new service attributes such as modal control delegation, transportation flexibility and value-adding services in service choice of shippers is becoming apparent. In the literature, however, discussion of these topics has been rare. In addition, the impacts of contextual factors of demand such as shippers' internal flexibility capabilities, end-consumer demand volatility and underlying supply chain strategies needed revisiting to understand the ability of shippers to respond to these service attributes in their service choices.

In this article, we investigate how shippers demand characteristics, i.e., modal control delegation, transportation flexibility and value-adding services, and the contextual factors of demand, i.e., shippers' internal flexibility capabilities, end-consumer demand volatility and underlying supply chain strategies, impact the choice of modern logistics services. We define the concept of service choice approach in section 2. Section 3 presents our findings from a comprehensive study about shipper preferences. In section 4 we discuss practical and academic implications. Section 5 presents research limitations, future directions and conclude the paper.

2. The service choice approach to freight transportation demand

Shippers determine many, if not all aspects of a transportation service, when they place a transportation order to the LSPs [13]. Figure 1 shows demand and supply interaction in a typical freight transportation system, where shippers place transportation

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service orders based on their preferences and business requirements [36], [37], [38],[41]. At the supply side, LSPs design and deliver transportation service packages based on their customers' preferences. The price of service packages is determined via the LSP's pricing and revenue management system[3] which closely connects with their supply and capacity planning system. In order to deliver the transportation service, LSPs need to supply different resources, i.e., transportation modes, from resource providers or from their own resources.

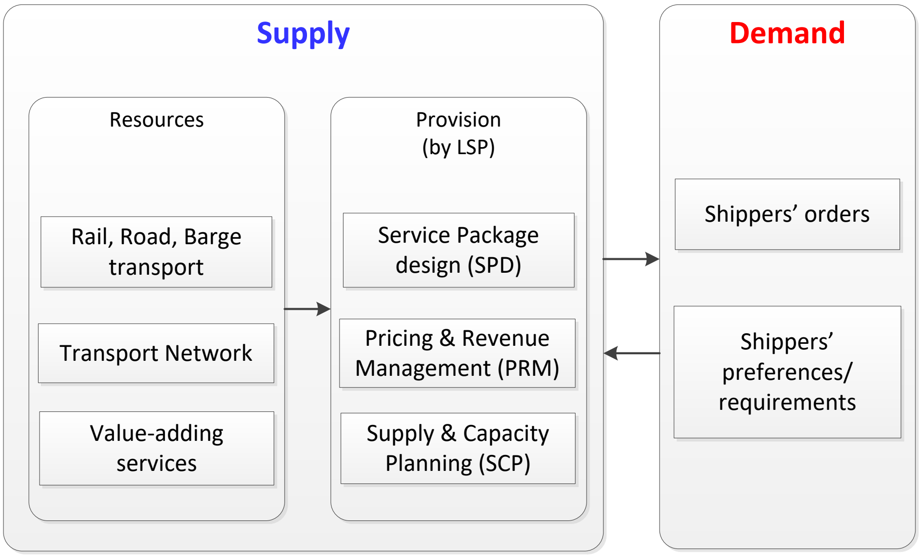

Figure 1. Typical freight transportation system (adapted and developed from [36], [37], [38],[41])

When looking at freight demand from a service choice perspective, one explicitly recognizes the components or dimensions of a service. These components can be bundled in many different combinations to enable LSPs offer a spectrum of services from simple and conventional transportation services (i.e., a low-cost service) up to highly customized service packages to the shippers to account for heterogeneity and variety in shippers' preferences and demand. From a service

[3] Revenue Management (RM) is the study of disciplined tactics for making product/service availability and pricing decisions, aiming at maximizing revenue growth [14].

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choice perspective, service components of a freight transportation service typically include [36], [37], [38],[41],[42]:

- An origin and destination location such as warehouse, terminal or a city
- One or more transportation mode(s) such as rail, road, waterway and air
- Transportation routes
- Service lead times
- Total price
- Service reliability i.e., on-time delivery of the goods
- Service flexibility i.e., adaptability of service to changes in the order
- Service frequency or availability
- Commodity type(s)
- Required value-adding service(s) e.g., tracking, packaging, customs, assembly of parts
- Order time or demand generation time such as normal or peak period
- Shipment quantity i.e., number of containers
- Shipper/client relation such as loyalty customer or need-based customer
- Service capacity
- Service competition

A solid understanding of shippers' demand characteristics is needed by LSPs to make effective decisions for their supply and capacity planning (SCP) [15], service package design (SPD) [39] and pricing and revenue management system (PRM) [14]. Each of these three functions involve decisions at the strategic, tactical, and operational levels [42]. Using [36], [38], [39], [42], we developed Table 1 to illustrate different types of activities, decisions and processes in the aforementioned business processes that need understanding of shippers' demand. In the SPD function and at the strategic level, LSPs need the demand information to identify and understand customers' preferences in long-term in order to segment customers and design relevant services for them. This will help design special service packages for loyal

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customers and regular service packages for need-based customers. In addition, the demand information would help determine the level of service attributes based on the needs of each market segment and the overall market share of each service package. At the tactical decision-making level of the SPD function, LSPs need to have a good understanding of demand information to incorporate flexibility into service packages to enable shippers address their market demand fluctuations. This will lead to the operational level decision of adjusting and rearranging services based on customer's requests on a short-term basis.

In the SCP function and at the strategic time horizon, LSPs mainly need the demand information to estimate the required capacity and associated resources to provide different service offerings to shippers. When it comes to the tactical time horizon, LSPs need the demand information to determine the amount of capacity they need annually and which services they need to provide themselves or purchase/hire from other service providers. In addition, they need to decide about static or dynamic capacity allocation mechanisms for their services/customers. At the operational level, LSPs need the demand information to decide about the required daily capacity of each service and efficient operations scheduling.

Concerning the PRM function and at the strategic level, the demand information are critical for LSPs to forecast long-term demand in the market and potential revenue growth regarding long-term shifts in demand, devise relevant pricing strategies with respect to the predicted demand, and determine the required long-term revenue generation to achieve financial plans of the company. At the midterm horizon, demand information should be fuelled into revenue management techniques to capture revenue opportunities based on resource utilization rates. Furthermore, dynamic demand forecasting techniques could be used to determine dynamic pricing of the services. When it comes to the operational level,

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LSPs need to incorporate micro demand fluctuations into their strategic/tactical demand forecasts to increase accuracy of demand forecasts.

Table1. The need for demand information in different activities, decisions and processes of LSPs (adapted and developed from [36], [38], [39], [42])

Purpose of using demand information	***Service package design (SPD)***	***Supply & capacity planning (SCP)***	***Pricing & revenue management (PRM)***
Strategic decisions (A few years)	* Understanding customers' preferences in long-term * Designing special service packages for loyalty customers * Designing regular services for need-based customers * Determining level of service attributes	*Estimating required capacity and associated resources (Volume, TEU, Tonne)	* How much revenue generation is required in the long-term financial plans of the company * Long-term pricing strategies with regards to long-term demand forecasts * Potential revenue growth regarding long-term shifts in demand
Tactical decisions (Annually)	* Designing flexible service packages capable of fulfilling demand fluctuations	*Which services to purchase and how much capacity *Which services to hire and how much capacity *Static capacity allocation or dynamic	*Capturing revenue opportunities based on resource utilization rates * Dynamic pricing of the services based on the dynamic demand forecasts
Operational decisions (Daily, Weekly, Monthly)	* Adjusting and rearranging services based on customer's requests	*Required daily capacity of each service *Efficient operations scheduling	* Incorporating micro demand fluctuations into the regular demand forecast

After demonstrating the service choice approach and the need for demand information in different activities of LSPs, in the next section we present findings of our survey about service requirements of global shipper firms.

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3. Service requirements of shippers: survey results

In order to understand how new service attributes and different contextual factors impact the service choices of shippers, we conducted a comprehensive study among 556 firms, sampled from the lists of (1) Global Fortune 500 companies [16] and (2) major customer firms of the 40 largest global LSPs [17]. Together these represent many different industries and account for the majority of global transportation volume and value. The subject of the survey was a service choice study to identify demand preferences of shippers choosing a transportation service. We designed a discrete choice experiment based on the random utility theory introduced by [30] as one of the well-established methods in econometrics to elicit the preferences and taste heterogeneity of customers in Business-to-Consumer and Business-to-Business markets [31]. Apart from the discrete choice experiment, we also designed a questionnaire based on the Best-Worst Method (BWM) (see [18]) as one of the multi-criteria decision-making (MCDM) methods. In general, MCDM methods are used to evaluate a set of alternatives with respect to a set of decision criteria. We chose BWM since it has several salient features, including data (and time)-efficiency and allowing for checking the consistency of the provided pairwise comparisons [32].

In total, we approached 2752 top and senior managers in the supply chain, transportation, logistics and distribution functions (e.g., director of logistics, vice-president of supply chain) via a web-based survey. Altogether, 296 professionals from 194 unique firms responded to our survey, which resulted in the largest survey sample on this topic to date. For a detailed account of the study, we refer the reader to [8] and [43]. We summarize the findings below.

3.1. New service attributes and their impact on shippers' service choice

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While transportation cost, time and reliability are conventional service attributes used in almost all mode choice studies, we introduced three new attributes that are necessary for developing tailor-made services packages based on the service choice approach: modal control, flexibility and value-added services (see Table 2). *Modal control* reflects the authority level of a shipper to decide its preferred transportation mode. While most shippers (about 80% in our study) determine the transportation mode for LSPs as part of their service request, the delegation of modal control authority to the LSPs provides significant additional freedom for LSPs to improve their performance, through real-time switching between different modes of transportation based on network circumstances. Modal control delegation is a fundamental prerequisite for future innovations in freight logistics in order to achieve an efficient and integrated logistics network (a.k.a. Physical Internet; see [19]). Our findings illustrate the strong connection between modal control and service choice: we find that over two-thirds of shippers may be willing to relinquish control over transportation modes and routes, if they are rewarded by better services or lower costs. *Flexibility* is defined as the ability of a transportation service to satisfy requests for change in service components during booking *and* execution of the transportation service. This may involve delivery time/location, shortening or extending lead times, and consolidating or deconsolidating volume/variety via warehouses or cross-docking terminals (mode-volume switch locations). Compared to earlier research, *en-route* flexibility in such an investigation is a new component. The third new attribute is *value-added services*, or ancillary services beyond the basic transportation service, which hasn't received significant attention in relevant literature either.

Table 2. Logistics service attributes (adapted from [8], [43])

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Door-To-door *Cost* ($): Total amount of money that the shipper pays to the LSP for shipping one TEU (20-foot container) from origin to destination (adapted from [43]).

Door-To-door *Time* (days): Duration from the shipment's first origin to the final destination (adapted from [44]).

Control (service level): The authority level of the shipper to decide about its preferred transportation mode and route ([8], [43])

Flexibility (service level): The capability to fulfil a shipper's required changes in service components before finalizing the booking of logistics service and even while goods are on their move toward the destination. Examples of these changes include change in delivery time/location, shorten or extend lead times, consolidate or deconsolidate volume/variety via warehouses or cross-docking terminals (mode-volume switch locations) ([8], [43]).

Reliability (% delivery times): The on-time delivery of freight/goods at the destination (adapted from [44]).

Value-added services (VAS) (service level): Ancillary services, including tracking and tracing, customs, handling and packaging offered by the LSP beyond the main logistics service (adapted from [45]).

Based on the research we can identify four different market segments for cost and service level improvements toward the global community of LSPs, freight forwarders and carriers (Figure 2). The horizontal axis indicates whether firms are willing to yield control over the mode of transport, the vertical axis shows the inclination of the firm towards a high performing or low-cost services. The percentages indicate the share of the firms sampled that fall within a category, adding to 100%.

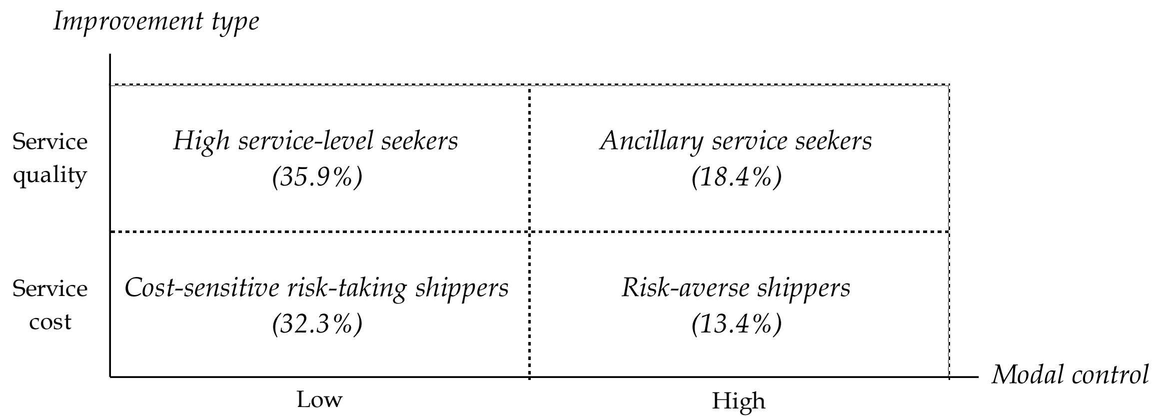

Figure 2. Market segments based on improvement type and modal control (Source: [8])

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Our results show that there is at least one segment in the market willing to consider and pay for each of the three new attributes i.e., *high service-level seekers* and *cost-sensitive risk-taking shippers* for Modal control delegation; *high service-level seekers* for transportation flexibility, and *ancillary service seekers* for value-added services. *High service-level seekers* are generally dissatisfied with the current services in the market and have a high willingness to delegate modal control and use synchromodal services, on the condition that LSPs secure fast, flexible and reliable transportation services. High service-level seekers are mostly very large companies with annual revenues above US$ 10 billion. From a revenue management perspective, LSPs can expect high revenue generation from the *High service-level seekers* since they present the highest willingness to pay for fast, flexible, and reliable transportation services [8]. For this shipper segment, service quality has a higher priority compared to price, which could motivate LSPs to provide a variety of tailor-made transportation services for their shippers. *Cost-sensitive risk-taking shippers* are mainly willing to relinquish modal control in exchange for cheaper transportation services. These shippers are usually large companies with annual revenue of US$ 1 to 10 billion. High revenue generation is not expected from this class of shippers because they are mainly looking for low-cost transportation services and would like to get higher service quality if the price is not more than the market norm [8]. The third shipper segment is called *ancillary service seekers* and is composed of small-to-medium-sized Fortune companies who are usually willing to delegate modal control by shifting towards synchromodal services that include their desired value-added services. The main revenue generation stream for this group of shippers is offering value-added services. Therefore, LSPs could invest on developing and offering new technological, digital, and organizational value-added services for *ancillary service seekers* as a

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strategic revenue stream beyond the main transportation service [8]. *Risk-averse shippers* group is the fourth shipper segment. Shippers in this segment prefer using their current transportation services and are not willing to take the risk of moving to synchromodal transportation or losing modal control. With respect to the revenue generation opportunities, LSPs could consider only services that do not need shippers to delegate control and has a lower cost compared to the market rates [8]. LSPs can explore targeted improvement opportunities in these four market segments to improve their market share and revenue margins, by designing tailor-made transportation services for their customers.

3.2. Contextual factors of demand and their role in shippers' service choice

From the survey it became clear that service preferences are strongly dependent on the business context that shippers operate in. We discuss the influence of 3 important contextual factors: demand volatility, internal flexibility and supply chain strategy [43].

Demand volatility is the most important type of supply chain uncertainty that significantly challenges supply chain competitiveness ([20],[21]). The survey clearly showed that shippers in demand-volatile markets choose LSP-driven flexible services as a major service component. On the contrary, shippers operating in stable markets i.e., stable demand, would mainly favor a conventional cost-efficient logistics service for addressing their logistical needs. LSP-driven flexible logistics services are an external flexibility for shipper firms.

We also investigated how this is matched with flexibility that shippers can offer themselves, also known as *internal flexibilities.* Shippers who prefer a flexible transportation service mostly appear to exhibit high volume flexibility, and to a lesser extent other internal flexibilities i.e., product, launch, sourcing and

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postponement flexibility[4] [43]. Shippers that operate in volatile markets and exhibit volume flexibility appeared to benefit most from LSP-driven flexible transportation services. This indicates that firms see flexible transportation services as a tool to supplement their own volume flexibility [43].

Supply chain strategies proved to be another relevant contextual factor. [22] introduced four types of supply chain strategies concerning demand and supply uncertainties of products, i.e., efficient supply chain strategy for products with low demand and low supply uncertainty, responsive supply chain strategy for products with low supply uncertainty and high demand uncertainty, risk-hedging supply chain strategy for products with high supply uncertainty and low demand uncertainty, and *agile* supply chain strategy for products with high supply uncertainty and high demand uncertainty. In general, shippers operating with an efficient supply chain strategy would be expected to choose a low-cost transportation service. For risk-hedging, responsive and agile supply chain strategies, a cost-efficient, reliability-oriented, and fast-and-flexible transportation would be expected. In our study, we found several counter-intuitive examples, however, which seem to rule out supply chain strategy as a single determinant of transportation choices. For example, companies operating in the healthcare industry mostly seek a reliable, fast and flexible transportation strategy (which is not necessarily cost-efficient) for their efficient supply chain strategy. In another case, firms in the technology and telecommunications industries, with an innovative product, high volume

[4] Volume flexibility is the firm's ability to effectively increase or decrease aggregate production in response to customer demand. Product (or mix or product-mix) flexibility is the ability of a firm to handle changes in the product mix and product design relative to customer demand. Launch (or new product development) flexibility is the ability to rapidly introduce many new products and product varieties. Sourcing flexibility is the ability to find another supplier for each specific component or raw material. Postponement flexibility is the capability of keeping products in their generic form as long as possible, in order to incorporate the customer's product requirements in later stages [23].

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uncertainties and an agile supply chain strategy, appear to apply a cost-efficient transportation strategy. These examples illustrate that the service choice of shippers is differentiated, based on the nature of industry and dynamics of demand, supply, and operations. Overall, we find that there is no single type of transportation strategy for each supply chain strategy and a *customized* transportation strategy, and a *tailor-made* transportation service based on the shippers' industry nature and supply chain strategy drives their demand for freight services.

4. Implications for practice and research

4.1. Implications for practice

We expect that a deeper understanding of transportation service requirements will lead LSPs towards designing more fitting transportation service packages. If the business context of a shipper is a very competitive market with much demand fluctuation and many supply disruptions (e.g., the apparel industry), the shipper may have an agile and/or responsive supply chain strategy for its products. LSPs will want to offer a flexible, reliable and fast transportation services to help operationalize this strategy. As a real-world example, Under Armour, a fast-growing sportswear brand worldwide, utilizes the DSV's multi-user warehouses as hubs to respond flexibly to their extraordinary rapid growth and the demand fluctuations in the market [24].

Transportation innovations and capability enhancements may improve total supply chain integration of shipper firms ([25],[26]). Synchromodal transportation services could support shippers' supply chain integration when LSPs share their resources toward collaborative planning forecasting and replenishment (CPFR) activities [27]. LSPs could establish mode-volume switch locations in their synchromodal transportation network, as shared warehousing hubs capable of

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aggregating and deconsolidating shippers' goods. Our study indicates that such supply chain solutions would need to be supported by fitting transportation services, where price and modal control matter less than appropriate performance levels in flexibility and ancillary services.

Another major area of logistics innovation is e-commerce and the associated omni-channel service propositions, putting logistics under pressure due to their strong growth and the need for vertical and horizontal integration. According to [28], 5 critical capabilities are needed to build and maintain flourishing ecommerce operations: agile distribution networks; transportation flexibility; inventory visibility and order orchestration; customer experience and IT; and software optimization. From a demand perspective, the first 4 capabilities are directly associated with a basic understanding of the demand of shippers and their end consumers. Shippers generally need agile distribution networks to allow flexible delivery and return shipping. Some need transportation flexibility to allow delivery to customers around the world with short lead-times. Main logistics-related capabilities required to improve customer experience of shippers are customers' ability to modify orders, the level of customization of delivery options, tracking facilities and VASs.

In order to improve the overall efficiency, effectiveness, and integration of the global transportation and supply chain via designing and developing innovative transportation services, below we recommend relevant guidelines to managers of shipper firms, LSPs and policymakers.

Guidelines to managers of shipper firms to identify their need for innovative transportation services and request it from LSPs:

- Define transportation strategies relevant to each product category. Consider contextual factors of your supply chains, demand fluctuations and customers' requirements.

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- For each transportation strategy, identify main service attributes that should be requested from your LSP.
- Investigate what type of relationship with your LSP (short-term, mid-term or long-term collaboration/partnership) will best address your transportation strategies.
- Review changes in your demand continuously and update your required transportation strategies accordingly.

Guidelines for managers of LSPs for providing innovative transportation services for shippers and performing better demand chain management:

- Devise effective demand chain management strategies to dynamically match freight demand and supply in the long-term and short-term time horizons
- Design customized service solutions for diverse supply chain strategies and segments of shippers.
- Predict what new service attributes might be required and develop your service portfolio accordingly.
- Consider that service robustness and flexibility may be needs not expressed explicitly by shippers.

Guidelines for policymakers in governmental organizations/authorities and providers of public infrastructure to promote logistics innovations from three perspectives: logistics operations, ICT infrastructures, and rules/regulations.

- With respect to logistics operations, public policymakers need to enhance the existing infrastructure and service investments to enable LSPs to provide innovative logistics service packages for shipper firms. This could be done via, for example, supporting regional transportation networks that allow switching between transportation modes and establishing more warehousing/mode-volume switch locations in the logistics network to

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support transportation flexibility and resilience. They can also support community roadmaps for the creation of transportation services that align with supply chain needs.

- The next important category is supporting the uptake of ICT infrastructure required by LSPs and shippers for real-time support to innovative logistics systems.
- Another major role of public policymakers is in adopting proper international rules and regulations to pave the way for a true provision and utilization of innovative logistics services internationally. Public policymakers can also use financial or non-financial incentives to encourage LSPs and shippers to improve the integration of the global logistics network. This will help satisfy the share of transportation in achieving global sustainability visions such as UN Paris agreement [49] and EU Green Deal [50].

4.2. Implications for research

Further to the above managerial implications, we introduce three important implications for research. First, this study identified emerging innovative transportation service attributes. This will create the need for academic research to investigate the role of innovative transportation services in the business performance of shipper firms. Several in-depth case study research can be conducted to explore how using these new attributes will impact shipper firms' financial performance, i.e., profit margin and environmental sustainability (e.g., carbon emissions). This can be done using methods such as Structural Equation Modeling [46]. For instance, scholars can investigate the question of "how using flexible transportation services to address supply chain uncertainties, e.g., supply disruptions and demand fluctuations, will impact

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financial, environmental, and social indicators of shipper firms?"

Second, we discussed the role that contextual factors of demand, including supply chain strategy, demand volatility, and supply chain internal flexibility, play in transportation service choice. Since contextual business factors influence the demand for innovative transportation services further research is needed to develop demand forecasting models for innovative logistics services and systems such as synchromodality. An illustrative example is forecasting the number of containers shipped via seaports in synchromodal transportation system in short-term. Using methodologies such as time series regression methods and Bayesian regression [47], scholars could come up with models for short-term forecast of synchromodal freight volume (in terms of container quantity) with multiple attributes.

Third, we highlighted the importance of moving from mode choice to service choice approach. When shippers look at transportation as a service with a variety of features, several revenue management opportunities can be identified for LSPs since it is primarily based on dynamics in demand and price. Here, scholars could conduct research on the impact of shippers' preferences and forecasted demand on the LSPs' revenue management. To this end, operational research methods could be applied. In particular, when there are uncertainties in supply and demand, methods for optimization under uncertainty such as stochastic and robust optimization could be applied. Another relevant topic here is forecasting changes in long-term freight transportation demand in presence of LSPs' different revenue management strategies. To achieve this goal, one can simulate revenue management strategies for the long-term business strategy of an LSP using, for example, scenario planning and/or system dynamics approaches. Then, optimization models could be used to measure the impacts of applying different

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revenue management strategies on long-term freight demand. For both above examples, a logistics innovation such as synchromdal transportation could be applied as a case study. Finally, since a better understanding of freight demand directly impacts the demand-supply integration, this could lead to a more effective demand chain management. Here, research scholars can work on the operational and organizational aspects of managing the demand chain, in particular, the interface of transportation and supply chain management.

5. Conclusions, limitations and future research directions

We presented the concept of a service choice approach in freight transportation and discussed how a better understanding of freight demand characteristics could improve service package design, including subsequent direct benefits for the supply chain. We discussed relevant new transportation service attributes that LSPs and shipper should consider, including modal control delegation, service flexibility and value-added services. We argued the importance of contextual factors of demand such as shippers' supply chain strategy, demand volatility, internal flexibilities and industry nature on their choice of LSPs' services.

This study has some limitations. While it discusses several new service features based on the recent transportation innovations, it has not considered the nature and dynamics of operations in particular shipper industries, which could potentially reveal some new service features. Therefore, operational context of different shipper industries could be considered to identify new service attributes and features. Another limitation is having access to a limited number of LSP's managers responsible for designing innovative service packages. This limitation also could constrain our identification of emerging service features of innovative transportation

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services. Thus, research scholars can broaden their respondent population by focusing on LSP managers in specific industries, geographical areas, or commodity types to reveal emerging trends in freight transportation innovation.

A key research direction for the future entails the continued identification and measurement of new service attributes/components, relevant to modern logistics requirements and future innovations in freight transportation that are yet to appear in our line of sight. For transportation, a shift of mind-set from a mode choice approach to a service choice approach allows to make the link to the supply chain context. As the main connector of all the nodes in the supply chain network, transportation can play a key role in success of shipper firms when its potential for addressing shippers' needs is identified by academicians and practitioners.

A crucial research topic associated with freight demand is investigating required changes in the business models of LSPs when they want to establish innovative freight transportation services. To this end, the following research questions could be considered: What would change in terms of business models if the LSPs start providing flexible services/synchromodal services/value-adding features? How should LSPs change their business to adapt to the shippers' changing preferences? If LSPs are going to collaborate with shippers to create innovative transportation services, what changes in their business models need to be made? What are viable collaborative strategies with competitors in order to establish tailor-made services for shippers? What sustainable business models could help LSPs develop effective logistics innovations?

Finally, scholars need to take a dynamic perspective into account with respect to future logistics services. As shippers' attitudes and preferences evolve over time according to technological developments, LSPs need to identify new preferences and

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adapt their business models and services accordingly. Scholars could apply simulation methodologies such as system dynamics [48] to measure and reflect the dynamic impacts of technological, regulative, environmental and social changes on the long-term performance of logistics innovations as they become mainstream in the global logistics network. Finally, it is also interesting to investigate the co-evolution of technological aspects and behavioral patterns in the stakeholders of the transportation system. Such an investigation can be done by agent-based modeling.

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