Identifying shippers' attitudes towards synchromodal freight transport services

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Synchromodal transport is one of the recent innovations in the area of freight transport and logistics. In synchromodal transport, transport mode and route are chosen by logistics service providers (LSP) rather than shippers. This lose of control is a fundamental trade-off for shippers against better reliability and flexibility offered by LSPs. Understanding shippers' preferences when a large number of service combinations is introduced by LSPs in the context of synchromodal transport is not studied in the modal choice research and stated preference (SP) surveys. This research aims to capture the taste heterogeneity and dynamics of the shippers' requirements for synchromodal transport using advanced discrete choice models. SP data are collected through a web-based survey on the 500 global fortune companies. There are two main outcomes of the study. First, estimating freight shippers' preferences for the main attributes of the synchromodal transport service such as cost, transit time, reliability (punctuality), control, flexibility (changeability) and value-adding services (e,g., tracking and tracing, customs). Second, obtaining willingness to pay and elasticity of choice probabilities of different transport attributes for improving the service level.

Keywords: Synchromodal freight transport, shipper, supply chain, discrete choice modelling

Introduction

There is a rich literature of freight service preferences from the 1970s, in which studies on modal choice preferences can be divided into two categories. First one is specific modal choice where rail, road, truck, air or a combination of them as co-modal, multimodal and intermodal are being investigated through stated preference (SP) surveys. The second one is abstract mode choice where the mode of transport is not specific, and only service attributes demonstrate the transport service. In synchromodal transport, shippers do not select the transport mode and based on their needs; they can benefit from flexibility in choosing a variety of service packages. Understanding shipper's preferences when a large number of service combinations is introduced by Loistic Service Providers (LSP) is not studied in the abstract modal choice research/SP surveys. Arencibia et al. (2015), Duan et al. (2016), and Danielis et al. (2005) considered the heterogeneity in shippers' preferences using advanced choice experiments. In the research done by Rezaei et al.(2017), Witlox, F., & Vandaele, E. (2005) and Simongati, G. (2010) Multi Criteria Decision Making (MCDM) approach is applied in order to tackle different preference identification problems in the freight transport. However, these studies are either mode-specific or static, meaning that they did not reflect shippers' preferences during different seasons of a year. In fact, shippers' preferences are dynamically changing based on their product types, supply chain types and market conditions during high and low seasons. This research

aims at studying these heterogeneity and dynamics in shippers' preferences for synchromodal transport service considering it as an abstract mode choice study with attributes such as cost, transit time, reliability (punctuality), control, flexibility (changeability) and value-adding services (e,g., tracking and tracing, customs). Survey questions are based on the specific time (seasons) of the year to capture dynamics in the decision-making behavior of the shippers.

Research Methodology

To capture the heterogeneity and dynamics of the shippers' preferences for synchromodal transport, discrete choice models are developed in two steps. First, we developed an orthogonal design as a pilot study to estimate the priors for our main efficient design. Then the efficient design is developed using Ngene software (ChoiceMetrics, 2009) resulting in 6 choice tasks. The choice experiment is included in a web-based survey and distributed among 500 global fortune companies all around the world. In the survey, the following attributes of a synchromodal freight transport are considered:

- End-to-end cost is the total amount of money paid for shipping one TEU (20-foot container).
- End-to-end transport time is the duration from shipper's origin to destination.
- Reliability is considered as the on-time delivery of freight/goods at the destination.
- Control is the authority level of the shipper to decide about its preferred transport mode and/or route.
- Flexibility is transport service capability to effectively adapt/fulfil shipper's required changes, e.g., change delivery time/location using different transport modes, (de)consolidate volume/variety via warehousing/cross-docking in mode-volume switch locations, shorten lead times using alternative transport modes, decrease total cost via improving shipper's service level and LSP's resource utilization. The shipper has full authority over the volume-related decisions. The collaboration level of the shipper for mode(and/or route)-related decisions depends on the level of the control attribute of the transport service.
- Value-adding services (VAS) are all ancillary services such as tracking and tracing, customs, storage and handling offered by the LSP beyond the main transport service.

A total number of 2490 senior/middle and top-level managers of targeted companies responsible for supply chain, logistics and transport operations are contacted via email from December 2017 until January 2018. After three follow-up rounds, 204 usable responses are collected that provide 1776 usable choice tasks.

Initial results

We compared transport preferences of shippers from different product, supply chain and market related aspects. Initially we applied the Multinomial Logit model based on random utility maximisation (McFadden, 1974) under the assumption of linear utility, maximum likelihood estimates for the unknown set of parameters were obtained with the software Biogeme release 2.0 (Bierlaire, 2003). Estimation results for a Multinomial Logit model are as follow.

Aggregated preferences of all companies in Table 1 show that Cost and Time has the highest priority for shippers when they order a transport service to an LSP.

Table 1: Transport preferences of shippers

All data		
Attributes	Estimate	P-val
ASC (Current option)	**0.425**	0.00
Control	**0.859**	0.00
Cost	**-10**	0.00
Flexibility	**0.378**	0.00
Reliability	0.684	0.11
Time	**-1.04**	0.00
Value-adding services (VAS)	0.141	0.28

It is interesting to see different priorities for shippers considering business seasons. We consider high season when demand is high or highly fluctuating for products and low or normal season when demand is relatively stable or low. Table 2 highlights that in high season the relative importance of cost decreases, while that of control, flexibility, time and value-adding services increase.

Table 2: Transport preferences of shippers considering business seasons

Business season	High season		Low season	
Attributes	Estimate	P-val	Estimate	P-val
ASC (Current option)	**0.357**	0.1	**0.4**	0.00
Control	**1.19**	0.03	**0.747**	0.04
Cost	**-8.87**	0.01	**-10**	0.00
Flexibility	**0.729**	0	0.238	0.09
Reliability	0.165	0.85	**0.739**	0.15
Time	**-1.31**	0	**-0.913**	0.00
Value-adding services (VAS)	**0.632**	0.03	-0.051	0.74

Considering efficient supply chain type in Table 3, cost and time are the only significant factors for companies that handle some products via efficient supply chains. However, for responsive supply chain, flexibility and control are significant as well.

Table 3: Transport preferences of shippers considering supply chain types

Supply chain type	Responsive SC		Efficient SC	
Attributes	Estimate	P-val	Estimate	P-val
ASC (Current option)	**0.741**	0	0.172	0.17
Control	**1.21**	0.01	0.582	0.14
Cost	**-9.66**	0	**-10**	0.00
Flexibility	**0.588**	0	0.219	0.16
Reliability	1.27	0.08	0.288	0.61
Time	**-0.849**	0.02	**-1.19**	0.00
Value-adding services (VAS)	0.0386	0.86	0.2	0.24

We also considered two main aspects of products that impact their supply chain type, products' function and perishability. According to Christopher (2000), functional products have predictable and stable demand with long life cycles, such as toothbrushes, while Innovative products have relatively

unstable and/or unpredictable demand with shorter life cycles, such as a mobile phone. As mentioned by Christopher (2000), functional products should be handled by efficient supply chains and innovative products should be handles by responsive supply chains. As demonstrated in Table 4, shippers prefer reliability, time and control when they want to transport innovative products. However, while they mainly prefer Cost for functional products.

Perishability is also another important aspect that impacts transport service requirements of shippers. As Table 4 represents, shippers prefer Reliability and Flexibility for perishable products.

Table 4: Transport preferences of shippers considering product types

Product type	Innovative product		Functional product		Perishable product		Non-perishable product	
Attributes	Estimate	P-val	Estimate	P-val	Estimate	P-val	Estimate	P-val
ASC (Current option)	**1.04**	0.00	0.172	0.17	**0.513**	0.01	0.402	0.00
Control	**1.76**	0.00	0.582	0.14	0.742	0.24	0.887	0.01
Cost	-10	1.00	**-10**	0.00	-10	1.00	**-9.98**	0.00
Flexibility	0.401	0.07	0.219	0.16	**0.612**	0.02	0.315	0.02
Reliability	**2.2**	0.01	0.288	0.61	**1.87**	0.05	0.356	0.49
Time	**-1.18**	0.01	**-1.19**	0	0.775	0.10	**-1.12**	0.00
VAS	0.214	0.39	0.2	0.24	0.0047	0.99	0.176	0.27

In the next step we will use Mixed Logit and Nested Logit models as well. Also, the willingness to pay for synchromodal transport services will be reported.

Conclusion

This study sheds light on understanding heterogeneity and dynamics in shipper's behavior and demand characteristics towards synchromodal freight transport as one of the future developments in freight transport. Logistics companies that are providing synchromodal transport can gain better understanding of different segments of their market, which could significantly help them improve the efficiency of their systems via, for instance, optimal assignment of transport modes to different shippers. We think that such efficiency brings some environmental benefits for the society as well.

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