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Research article

Transportation capacity shortage influence on logistics performance: evidence from the driver shortage

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ARTICLE INFO	ABSTRACT
	The study aims to provide an in-depth analysis of a transportation capacity shortage issue affecting Australian logistics service providers. Transportation capacity shortage is an important issue in all transportation modes. In this study, the driver shortage is viewed as an antecedent variable to estimate the impact of transportation capacity shortage on logistics performance. This study investigates the underlying relationships between driver shortage, logistics capability, and logistics performance according to resource-based theory. Structural equation modeling (SEM) was used to analyze the measurement models and structural model. The empirical results illustrate that driver shortage indirectly influences logistics performance, the logistics capability is a mediator factor in the relationship between driver shortage and logistics performance in logistics service providers. We argue that this provides valuable insights for transportation capacity shortage management.

1. Introduction

Australian truck driver shortage is looming, the professional truck driver population is aging, and the future road freight demands without enough young men and women entering the industry may fail to meet our future freight demands. Australian Bureau of Statistics Labour Force Survey data suggests the average age of a truck driver at 48 years old and climbing, nearly half of the industry's current workforce will be over 65 by 2026. This will significantly impact the industries, including manufacturing, forest, and agriculture, which rely heavily on road transport to access the farms and forest land and must compete with other supply chains for sufficient drivers. Moreover, the truck driver shortage has caused severe transportation capacity shortages (Wang and Radics, 2019). Thus, this study focuses on the truck driver shortage in the logistics service providers (LSP); it is "a firm that provides a one stop shop service to its customers of outsourced (or "third party") logistics and delivery service for part, or all of their supply chain management functions" (Cowles, 2012, p. 47).

Logistics is a predominant part of the supply chain management that plans, implements, and controls the efficient, effective flow and storage of goods, services, and related information from the point-of-origin to the point-of-consumption in order to meet customers'

requirements (Lambert et al., 1998; Nagurney et al., 2015). Transportation capacity shortage has become a looming problem (Fugate et al., 2009; Meixell and Norbis, 2008). Fugate et al. (2009) urge that the transportation capacity shortage may influence the performance, e.g., on-time delivery and costs of coordination. Meixell and Norbis (2008) suggest that transportation capacity shortage is an important issue that has surfaced in logistics management due to capacity shortages in all transportation modes. In addition, transportation capacity is an essential component of the carrier industry; transportation capacity shortage may influence customer demand, efficiency, and price (Lindsey and Mahmassani, 2017). Therefore, it is essential to understand how capacity shortage influences operational performance change and manages transportation capacity. The resource-based view (RBV) can provide insight into the operational challenges; Wernerfelt (1984) suggested that the firm's capabilities and resources were used to achieve a sustainable competitive advantage. For example, the adoption of Industry 4.0 technologies enhances performance in Logistics 4.0 (Nantee and Sureeyatanapas, 2021) and procurement 4.0 (Bag et al., 2020). The RBV is adopted as an underlying theoretical foundation of the conceptual model. LSPs act as logistics coordinators in the supply chain to deliver freight for clients. They can be seen as supportive supply chain members that provide resources, knowledge, utilities, or

assets for the primary members of the supply chain (Lambert et al., 1998).

Recent supply chain management research tends to focus on logistics and supply chains (Flynn et al., 2018). Over the last two decades, an essential development in the supply chain network has been incorporating LSPs in the logistics market. More and more businesses now heavily relied on the LSPs. For example, Oxford University Press has used LSPs to perform the logistics function in Australia and New Zealand. The LSP's performance directly influences the entire supply chain operations (Wang, 2018). The transportation capacity shortage is an essential and practical issue in LSPs (Pellegrino et al., 2020). In addition, although with the rapid development of technology, robotic drivers (autonomous vehicles) means that drivers are becoming increasingly substitutable, truck drivers play a vital role in the logistics and transport firms (Min and Lambert, 2002; Searle, 2018); changing patterns of work have in recent years produced a significant, and growing, shortage of truck and machinery drivers in most OECD countries (Fugate et al., 2009; Searle, 2018; Whistler, 2012).

Based on existing literature, most deriver shortage studies focus on an individual level (Thomas et al., 2020; Williams et al., 2017) or environment recruitment/policy (Berman, 2017; Cassidy, 2014; Dawson, 2018). However, scholarly research has provided little in-depth analysis at an organizational level. There is very little published research on driver shortage impacts and how the driver shortage might be expected to influence a firm's logistics performance. Further, there is little insight into how firms can apply strategic resolutions to address the transportation capacity shortage issue from a logistics operations point of view. Therefore, the study attempts to understand the transportation capacity shortage by tackling the driver shortage issue in the Australian LSP. The research questions are formulated as follows,

RQ1 How does the driver shortage issue influence logistics performance?

RQ2 What are alternative strategies LSPs can adopt for mitigating transportation capacity shortage?

This research also responds to the call of the Australian and New Zealand governments to investigate the driver shortage issue in the logistics and transport industry. The conceptual framework was developed in earlier research (Wang and Radics, 2019), which the New Zealand government-funded from 2018 to 2019. The driver shortage is viewed as a transportation capacity shortage issue, and the empirical evidence from the Australian logistics service providers' driver shortage is presented. This study validates the model for understanding the relationships between driver shortage, logistics capability, and logistics performance from an LSP's perspective. Some valuable insights are offered to manage the driver shortage issue by deploying logistics capability to achieve sustainable development in the logistics and transport industry.

The rest of the paper is structured as follows. Section 2 describes the driver shortage and key concepts, including the logistics capability and performance. Section 3 presents the conceptual framework and hypotheses development. Section 4 describes the research methodology in this study. The data analysis and results are offered in section 5. Furthermore, the last section discusses significant findings, and managerial implications and concludes the paper.

2. Theoretical background

2.1. Driver shortage/transportation capacity shortage

While the driver shortages have been identified for a long time, but it has mainly been discussed in the trade magazines, newspaper articles, and reports (Romeo, 2018; Searle, 2018). This lack of academic research may impede the sustainable development of logistics and supply chain management. Previously, driver turnover has been an active research stream related to the driver shortage (Miller et al., 2020). However, the research stream on driver turnover studies has mainly sought to identify covariates that predict drivers' turnover intentions or actual driver exit

from an individual perspective (Miller et al., 2017; Saldanha et al., 2014; Thomas et al., 2020).

The driver shortage in the logistics and transport industry can be viewed from different angles; the driver shortage can be considered as an antecedent factor, a consequent effect, and/or phenomenon. Min and Lambert (2002) investigated the recruitment and retention strategies for managing the driver shortage issues using a survey. In addition, they assessed the impacts of driver shortage on competitiveness in American trucking firms. There is a real and immediate cost of staff turnover. They also identify that the shortage can detrimentally impact logistics productivity and customer service. Despite noting that truck safety is not affected, Terry (2004) identified that driver shortage was a primary factor responsible for increased logistics demand; other factors include high fuel prices, constrained capacity, increased insurance costs, and an uncertain economy.

Some other studies addressed the driver shortage in specific industries. For example, the lack of skilled drivers is the major challenge faced by the forest trucking industry in Maine (Koirala et al., 2016). Berman (2017) addressed that the driver shortage was an ongoing issue in the freight and transport sector. Williams et al. (2017) studied the psychological stressors which may influence the retention and driver's performance. Mittal et al. (2018) suggested that government should take initiatives to improve the situation and increase driver retention and job attraction. However, it is predominantly managed as an issue from an LSP's perspective. Ji-Hyland and Allen (2020) investigated the factors contributing to the driver shortage from driver recruitment and retention. Thomas et al. (2020) explore the relationship of three job burnout dimensions (exhaustion, cynicism, inefficacy) with role stressors and attitudinal job outcomes related to the truck driver shortage problem.

There are many identified causes of the driver shortage. For example, there are aging drivers, expensive licensing fees, and perceived poor work conditions in the American food industry (Dawson, 2018). The overall work conditions also include pay rates and work hours; many workers may expect greater financial compensation as work hours increase. Belzer and Sedo (2018) investigated this trade-off, and it has been suggested as a critical reason for the shortages. Offering better pay rates is one temporary way of solving the driver shortage (Shiers, 2015). Research by Canadian Trucking Human Resources Council proves that drivers also emphasize the importance of things like respect and support (Geller, 2011), suggesting that the overall work environment for drivers is also important.

2.2. Logistics capability

Logistics capability plays a central role in the LSPs, as LSPs provide transportation and logistics services, which heavily rely on the logistics capability to deliver the services for customers (Wang et al., 2018). According to RBV, the firms utilize the capability and resources to create competitive advantages (Wernerfelt, 1984; Yusuf et al., 2004). The capability is an organization's ability to assemble, integrate and deploy resources and perform some task or activity (Daugherty et al., 2009); resource is anything tangible or intangible owned or acquired by a firm (Hafeez et al., 2002). Logistics capability is a distinctive, important business capability in the integrative strategic process to create a competitive advantage (Wang et al., 2018; Wang, 2020). Therefore, truck drivers are viewed as one of the essential resources in the LSPs (Williams et al., 2017). In this paper, the logistics capability, including innovation (Wang et al., 2020), responsiveness (Wang et al., 2015), and flexibility (Wang and Jie, 2019) from an LSP's perspective.

Innovation is a firm's ability to transform knowledge and ideas into new products, processes, and systems for the firm's benefit (Lawson and Samson, 2001; Wang, 2016; Yang, 2012). Innovation capability has been suggested to be one of the crucial logistics capabilities (Wang et al., 2020). It has also been considered a strategic tool for enterprises to keep their competitive advantage (Wang, 2016). In this paper, the logistics innovation capability is defined as the LSPs' ability to conduct and

coordinate logistics-related activities and use related resources and skills to satisfy customers' real needs and wants.

Responsiveness is a firm's ability to service or respond to the customers. Morash et al. (1997) identified responsiveness as one of the critical logistics capabilities. In addition, customer service is a vital business function in LSPs to communicate with customers and deliver value and faster responsiveness. Also, notably, customer service is considered an essential logistics capability discussed in previous research (Fawcett and Cooper, 1998; Zhao, 2019). Zhao et al. (2001) found that customer-focused capabilities were significantly related to logistics performance. In this study, responsiveness includes the customer service and responsiveness capability (Lu and Yang, 2010).

Flexibility is the ability to respond to changes (Jain et al., 2013; Wang and Abareshi, 2019). It reflects an organization's ability to control and respond to unexpected circumstances or events (Naim et al., 2010; Prater et al., 2001; Vickery et al., 1999). Flexibility is an essential logistics capability in the LSPs (Naim et al., 2010; Prater et al., 2001). The different types of flexibility include internal to the organization or external, both proactive and reactive uses (De Toni and Tonchia, 1998; Naim et al., 2010; Sawhney, 2006). Flexibility is required to meet customers' expectations. Such as, global distribution coverage is the ability to effectively provide global distribution coverage (Jay Joong-Kun et al., 2008); this provides more options for customers' delivery. In addition, flexibility may be adopted to manage uncertainty, e.g., volume flexibility or operations flexibility (Jay Joong-Kun et al., 2008; Wang et al., 2015).

2.3. Logistics performance

According to the definition of logistics in operations management, logistics includes elements such as inbound to firm, outbound from the firm, warehouse (storage), and network design. Besides, the modern logistics and distribution system is customer-driven; it is essential to assess the logistics performance from a customer's perspective.

Moreover, a logistic function, managing materials, is different from an inter-firm supply chain function; some companies may not be involved in an end-to-end supply chain system but will still have a logistics function. For example, a real estate company does not necessarily need a supply chain network, but a logistics activity is required, e.g., sending legal documents to customers and receiving stationery. These businesses are more likely to use LSPs to perform the delivery. Therefore, the logistics function is an essential component in a supply chain and stands alone as a function required by most businesses as part of normal operations. The difference is that some companies may require a high level of logistics services and performance, and other companies very little.

"If you can't measure it, you can't manage it." Therefore, measuring performance is the key to improvement (Wang, 2018). Logistics performance is predominant for transport and logistics service providers in delivering value to members in the supply chains. It has been widely recognized as a critical factor in gaining a competitive advantage (Chow et al., 1994; Fawcett and Cooper, 1998; Helena, 2012). As the LSPs play a vital role in a supply chain system to deliver goods and information to link the different business partners in the supply chain (Christopher, 1998; Wang et al., 2015), the logistics performance is a success factor for both firms and their customers (Richard and Rein, 2004; Khan et al., 2019). The LSPs are affected by the logistics performance, but other supply chain members in the same network may suffer negative impacts (e.g., delay or damages). Thus, we considered these attributes from a customer's perspective in the logistics measurement in the firms, such as customer complaints, reputation, on-time delivery, damaged or lost freight, and information accuracy.

The popular attributes of logistics performance have been discussed widely in the previous studies. Customer service, an essential measure of logistics performance, was often mentioned in previous logistics studies (Fawcett and Cooper, 1998; Wang, 2018). Cost is always used as a key indicator of logistics performance (Christopher, 1998; Fawcett and Cooper, 1998; Garcia et al., 2011), while some other studies focus on

service quality such as environment, reliability and accuracy (e.g. on-time delivery, damage, disruptions) (Irene Gil et al., 2008; Stank et al., 1999; Khan, 2019).

3. A conceptual framework and hypotheses development

In this section, a conceptual framework and hypotheses development are presented. According to the RBV, the relationships between the driver shortage, logistics capability, and logistics performance are proposed in Figure 1; the conceptual framework was presented in the 17th Australian and New Zealand Academy of Management (ANZAM) Operations, Supply Chain and Services Management Symposium in the University of Melbourne, Melbourne, Australia (Wang and Radics, 2019). This paper presents an empirical analysis of the conceptual work.

3.1. Effects of driver shortage on logistics capability

Little research has been conducted on driver shortage and logistics capability. A shortage of drivers indicates the use of temporary workers that are not as committed or skilled and an inability to pass on knowledge and routines to new workers (Wang and Radics, 2019). The knowledge and expertise of experienced drivers are essential as they represent an 'operant resource' in the RBV. This means that the people and their capabilities can influence the effectiveness of managing operand resources, which is acted on in delivering a service. The operant resources alter and adjust or act on the operand resources, such as the flow of materials.

Logistics capability is viewed as an ability to respond to customer requests and resolve problems (Wang et al., 2015). Close contact with customers enables the drivers to be responsive to requirements. This co-creation activity entails the co-creation activity, with both parties using their knowledge and experience to ensure the logistics activities match customer requirements. The transportation capacity shortage may impede logistics service capability (Pellegrino et al., 2020). For example, Min and Lambert (2002) identified that customer service and driver shortages hurt logistics costs. In many cases, it will be the drivers who have the embedded knowledge about the logistics requirements and are also those with the most contact with customers. Therefore, the driver shortage may directly influence a range of logistics capabilities including innovation, responsiveness, and flexibility, and we hypothesize that:

H1. There is a negative relationship between the driver shortage and logistics capability in the LSPs.

3.2. Effects of driver shortage on logistics performance

The effects of driver shortage appear in reports and newspaper articles; i.e., the trucking industry has identified the lack of trained truck drivers as its top concern (Romeo, 2018). The truck driver shortage impacts the delivery time and cost of deliveries (Dawson, 2018). The driver
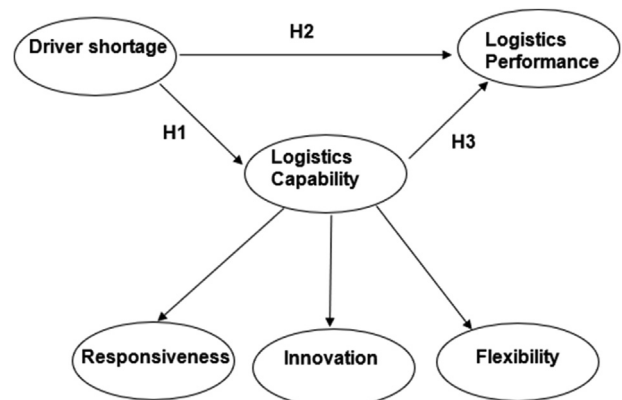

Figure 1. A conceptual framework.

shortage is considered a transportation capacity shortage, which may cause supply chain uncertainty and risk (Pellegrino et al., 2020; Wang et al., 2015). The supply chain uncertainty and risk influence logistics performance. For example, Wang (2018) identified the negative impacts of supply chain uncertainty and risk on logistics performance. In addition, the driver shortage may negatively affect an LSP's competitiveness (Min and Lambert, 2002). Dawson (2018) found that driver shortages can influence the price and on-time delivery; as driver pay increases due to the shortage, it significantly impacts the fleet. Transportation capacity shortage is a significant problem in the modern transportation and logistics industry (Pellegrino et al., 2020). In the conceptual framework, logistics performance is measured by on-time cost, customer service, and driver shortages that may cause delays, additional costs, and negative customer experience. Moreover, the negative impacts of the truck driver shortage appeared in the previous studies (Berman, 2017; Cassidy, 2014; Dawson, 2018). Therefore, it is hypothesized that:

H2. There is a negative relationship between the driver shortage and logistics performance in the LSPs.

3.3. Effects of logistics capability on logistics performance

Earlier logistics studies suggested that logistics capability was positively related to firm performance (Jay Joong-Kun et al., 2008; Lai, 2004; Zulkiffli, 2009). The logistics capabilities of LSPs may affect both operational performance and financial performance (Liu and Lyons, 2011). The logistics capability includes innovation, responsiveness, and flexibility; logistics innovation capability plays a central role in mitigating supply chain uncertainty and risk and improving logistics performance (Wang et al., 2020). Responsiveness represents customer service; Lai (2004) suggests that logistics service providers with better service capability should be better positioned to satisfy customers' needs for various logistics services and achieve better service performance. Flexibility is vital in creating transportation options to manage the shortage of transportation capacity (Pellegrino et al., 2020). Moreover, logistics capability can directly influence supply chain agility (Gligor and Holcomb, 2012). Therefore, logistics capability can achieve superior performance and sustained competitive advantage (Jay Joong-Kun et al., 2008). Thus, there is a close relationship between logistics capability and performance. Therefore, it is hypothesized that:

H3. There is a positive relationship between the logistics capability and logistics performance in the LSPs.

In the study, the logistics capability is a second-order construct, which is measured by these three dimensions including (1) innovation, (2) responsiveness, and (3) flexibility; they were identified and developed based on the actual logistics and transport operations and previous studies (Huang and Huang, 2012; Jain et al., 2013; Jay Joong-Kun et al., 2008; Kim, 2006; Lu and Yang, 2010; Morash et al., 1997).

4. Research methodology

We used a confirmatory structural equation modelling (SEM) approach to address the research question. The research models were validated by using the statistical package Amos 26 to conduct data analysis.

4.1. Instruments

According to the conceptual framework, the constructs include driver shortage, logistics capabilities, and logistics performance. The study measures the independent variable - driver shortage; very few earlier studies had attempted to measure the driver shortage. In this study, subjectivity is necessary for assessment; even in quantitative assessments, subjective judgment occurs (Bryman and Bell, 2011). However, the subjectivity does not diminish the value or credibility of the assessment process (Walter, 2013). The impacts of driver shortage were assessed to estimate the driver shortage. The respondents were asked to indicate the

severity of the driver shortage in their company recently. The logistics capability was assessed in terms of innovation, flexibility, and responsiveness. The logistics performance was compared to the major competitors in the market. The latent variables of interest were estimated through respondents' perceptual evaluation on a Likert-type scale. The 7-Point Likert scale items operationalized the driver shortage, logistics capabilities, and logistics performance. The questionnaire included driver shortage risk assessment, logistics capabilities assessment, and logistics performance assessment. The distributed survey contained a range of other questions; Appendix A provides only the items used in this research. The RMIT University Human Research Ethics Committee approved the research project; the study complied with all regulations and included the participants' informed consent.

4.2. Data collection

The study has been supported by the Chartered Institute of Logistics and Transport Australia (CILTA). A purposive sampling technique was used in this study; sample companies were selected from the Australian business directory, such as the Yellow Pages and the Australian Business Register. This allows researchers to choose the members of the population who are suitable for the research to participate in the study (Bryman and Bell, 2011). We invited relevant practitioners and selected the companies to complete the survey. We look at the driver shortage issue from an LSPs' perspective. All data were collected from respondents with relevant transportation and logistics experience and knowledge in the Australian LSPs. A cover letter explained the study and the relevant ethical considerations. Participation in the study was voluntary. Consequently, the results are reported in a manner that does not enable the respondents and their organizations to be identified.

An online questionnaire was designed for this study (Appendix A). The online survey technique provides a flexible way to collect data from states in Australia. The transportation and logistics companies were randomly selected from the yellow pages across Australia. A pilot study was conducted. We invited 15 people who were logistics and supply chain professionals and academics to review, answer the questions, and provide comments. Minor revision was performed to refine the survey. This pilot study ensures that the preliminary instrument was appropriate, valid, and well-developed before sending out the survey to all companies.

The respondents were from six states (New South Wales, Queensland, South Australia, Tasmania, Victoria, and Western Australia), three internal territories (the Australian Capital Territory, the Jervis Bay Territory, and the Northern Territory). Most of the respondents have managerial positions, including supervisors, departmental managers, and senior managers. Total 161 valid responses were included in the data analysis. This provided an approximate response rate of 16%.

5. Data analysis and results

SEM has become a popular statistical technique in today's business research (Henseler et al., 2009). Following the data analysis procedures (Joseph F. Hair, 2010; Lowery and Gaskin, 2014), there are two phases in the SEM-Path modeling algorithm: the estimation of the measurement model and the estimation of the parameters of the structural model (Henseler et al., 2009). This section presents a rigorous process to conduct the confirmatory factor analysis (CFA) for validating measurement models. The structure model was validated, and the relationships among the constructs were investigated for hypothesis testing. The reliability and validity are examined and reported in this section.

5.1. Reliability and validity

Traditional SEM approaches were applied to evaluate the measurement and structural models. Content and face validity were established by a pilot study consisting of a panel of experts and managers. According to the CFA, the logistics capability is specified as a second-order

construct, including innovation, flexibility, and responsiveness. Cronbach's alpha coefficient was used for estimating the reliability of multi-item scales. An alpha value of 0.70 or higher was considered to indicate acceptable reliability. Reliability analysis was performed using AMOS software. The construct reliability score as part of the integrated model analysis; each reflective construct should meet the recommended threshold of 0.70 (Hair, 2010). The empirical evidence provided in the analyses suggests that the measures included in the study possess sufficient reliability and validity to proceed with hypothesis testing. The results of constructs and measurement items are shown in Table 1.

5.2. Measurement model test

A confirmatory factor analysis (CFA) was conducted to validate the overall measurement model and assess the constructs' reliability and validity. The following specific metrics were calculated to determine the goodness of fit. The first- and second-order-constructs with reflective items suggest good indicator reliability (Table 2).

The convergent validity was tested by the Composite Reliability (CR) and Average Variance Extracted (AVE); CR should be above 0.6, and AVE should be above 0.5 for all constructs (Fornell and Larcker, 1981). The Maximum reliability MaxR(H) is a quantity that warrants close consideration when concerned with scale construction and development. Maximal reliability is never lower than the composite reliability coefficient (Raykov et al., 2016). The correlations of constructs and descriptive statistics are summarized in Table 3. The AVE for each research construct should be higher than the squared correlation between the construct and any other constructs (Hair, 2010). The Fornell-Larcker criterion is that the square root of the AVE for each construct should exceed the highest correlation of that construct with any other construct in the model (Hair et al., 2014). As shown in Table 3, the measurement model demonstrated that satisfactory discriminant validity was established. We tested the common method bias during the factor analysis by inspecting the eigenvalues through unrotated factor analysis (Podsakoff et al., 2003). The

results showed that neither any single factor nor the first factor represented a value greater than 20% of the variances in our data. Thus, common method bias is not a concern in this study.

5.3. Hypotheses testing and results

The hypotheses testing was conducted in the structural model. Amos 26.0 is used to validate the proposed structure model and test the hypothesized relationships. The SEM analysis yielded satisfactory key model fit indices with chi-square = 222.555 (df = 144, p < .001), chi-square/df(CMIN/DF) = 1.546, CFI = 0.958, RMSEA = 0.058, SRMR = 0.057, PClose = 0.177. The Amos output on paths' standardized regression weights with relevant critical ratios (CR) and p-value was used to test each hypothesis. Critical ratios of regression weights of the items were significant (>1.96) for latent variables, suggesting that unidimensionality and convergent validity for each construct were validated. Table 4 illustrates the results of the structural model tested.

H1 examines the relationship between a transportation capacity shortage and logistics capability, supported with standardized regression weight = -0.430, CR = -4.435, and p < 0.001. The empirical evidence indicated that the driver shortage had a negative impact on the logistics capability of the LSPs. H2 examines the relationship between the driver shortage and logistics performance in the model; the result is not supported by empirical evidence. We did not find a significant direct effect of the driver shortage on logistics performance in this model because logistics capability is a mediator, which completely mediates the relationship between driver shortage and logistics performance. Table 5 shows the linear regression model results. First, we tested the relationships between the driver shortage, logistics capability, and logistics performance, respectively (model 1 &2 in Table 5); the results indicated that the relationships were statistically significant. However, when mediator logistics capability was introduced in model 3, the relationship between driver shortage and logistics performance became statistically insignificant. The results prove that the model's complete mediation and

Table 1. Constructs and measurement items.

Constructs and Measurement Items	Mean	Std. Dev.	Factor Loadings
Driver Shortage (Cronbach's Alpha = 0.83, CR = 0.90, AVE = 0.75)			
D1 Labour/driver shortage (External)	2.43	1.40	0.70
D2 Inadequate operational strength (Internal)	2.32	1.257	0.90
D3 Delays in pickup/delivery	2.50	1.157	0.78
Logistics Capability (Cronbach's Alpha = 0.88, CR = 0.90, AVE = 0.53)			
Innovation (Cronbach's Alpha = 0.84, CR =0.90, AVE = 0.76)			
I1 Simplification of operations	5.78	1.18	0.91
I2 Standardisation of operations	5.91	1.09	0.80
I3 Technology for freight safety and risk	6.09	1.03	0.83
Flexibility (Cronbach's Alpha = 0.79, CR =0.87, AVE = 0.71)			
F1 Routine services	6.17	0.84	0.73
F2 Skilled and qualified personnel	6.03	1.05	0.78
F3 Flexible delivery scheduling and routing	5.92	1.14	0.73
Responsiveness (Cronbach's Alpha = 0.77, CR =0.86, AVE = 0.69)			
R1 Solving problems and complaints	6.28	0.76	0.72
R2 Consistent customer service	5.89	0.91	0.70
R3 Managing freight damage/loss rate	6.03	0.94	0.76
Logistics Performance (Cronbach's Alpha = 0.93, CR = 0.94, AVE = 0.71)			
P1 Less damaged/lost freight	5.73	1.151	0.80
P2 Low rate of customer complaint	5.60	1.305	0.82
P3 On-time and accurate delivery	5.73	1.128	0.86
P4 Higher customer satisfaction	5.85	1.085	0.94
P5 Short customer response time	5.81	1.202	0.77
P6 Reputation in the industry	6.17	1.130	0.71
P7 Accurate billing/transit/delivery information	5.83	1.121	0.79

Table 2. Measurement model results.

Path	Standardized Weights	Critical Ratio	p-value
Innovation <—Logistics Capability	0.73	(Fixed)	
Responsiveness <—Logistics Capability	0.98	6.528	<0.001
Flexibility <—Logistics Capability	0.863	6.560	<0.001
I1<—Innovation	0.82	9.669	<0.001
I2<—Innovation	0.874	10.039	<0.001
I3<—Innovation	0.727	(Fixed)	
R1<—Responsiveness	0.709	8.18	<0.001
R2<—Responsiveness	0.712	(Fixed)	
R3<—Responsiveness	0.77	8.822	<0.001
F1<—Flexibility	0.728	8.826	<0.001
F2<—Flexibility	0.783	(Fixed)	
F3<—Flexibility	0.729	8.84	<0.001
P1<—Performance	0.825	(fixed)	
P2<—Performance	0.841	13.005	<0.001
P3<—Performance	0.853	13.32	<0.001
P3<—Performance	0.933	15.409	<0.001
P4<—Performance	0.765	11.294	<0.001
P5<—Performance	0.702	10.033	<0.001
P6<—Performance	0.785	11.729	<0.001
D1<— Driver Shortage	0.712	(Fixed)	
D2<— Driver Shortage	0.895	13.606	<0.001
D3<— Driver Shortage	0.784	11.678	<0.001

Fit statistics: Chi-square = 222.552 (df = 144, p < .001), Chi-square/df (CMIN/DF) = 1.546 CFI = 0.958, RMSEA = 0.058, SRMR = 0.061.

Table 3. Correlation matrix and validity analysis.

	CR	AVE	MSV	MaxR(H)	LP	DS	LC
LP	0.933	0.669	0.489	0.947	**0.818**		
DS	0.842	0.641	0.190	0.870	-0.243**	**0.801**	
LC	0.899	0.751	0.489	0.978	0.699***	-0.436***	**0.867**

Note: *The square root of the average variance extracted (AVE) is shown on the diagonal of the matrix in bold. Significance of Correlations: *p < 0.050 **p < 0.010 ***p < 0.001.

logistics capability is a mediator between driver shortage and logistics performance. Finally, H3 investigates the logistics capability and logistics performance relationship, supported with standardized regression weight = 0.715, CR = 6.823, and p < 0.001. Figure 2 presents a path model with significant relationships.

The Sobel test also was conducted to confirm the mediation effect in the model. The results (Test statistic: -4.14, Std. Error: 0.046, p-value: <0.001) show that the indirect effect of the driver shortage on the logistics performance via the mediator logistics capability is statistically significant.

6. Discussion and conclusion

The purpose of this study is to address questions pertaining to the transportation capacity shortage issue empirically. The driver shortage is one of the problems in the transportation and logistics industry (Wang

and Radics, 2019). Researchers have conducted studies to understand the causes of drivers' shortages and policies (Min and Lambert, 2002; Mittal et al., 2018). This study provides a particular angle to optimize the internal logistics operations to mitigate the negative impacts of the truck driver's shortage in the LSPs, as we find that logistics capability as a mediator between driver shortage and logistics performance. The driver shortage has become a looming problem in many countries (Romeo, 2018). However, very few studies have been conducted on driver shortage studies in the Australian logistics and transport sector.

This empirical study focuses on the driver shortage, which presents a transportation capacity issue in the LSPs; the research model examines the impacts of the driver shortage in LSPs and reveals the mechanism of how the impacts of driver shortage can be influenced by deploying the relevant logistics capabilities, such as innovation, responsiveness, and flexibility. Besides, those capabilities are essential to build resilience in industry 4.0 and post COVID-19 recovery. Complete mediation was identified in the model.

With a growing number of LSPs offering fast delivery and quick response, the LSPs require better logistics performance to compete in the market and achieve sustainable development. Using LSPs allows firms easy access to logistics services and markets; the logistics capability plays a central role in integrating the supply chain (Flynn et al., 2010). This implies that LSPs should support their business customers' alternative business strategies, including supply chain and marketing strategies (Christopher, 2005; Frazelle, 2002). Service quality and price are essential considerations for decision-makers in transport service selection (Nagurney et al., 2015). However, transportation capacity shortage

Table 4. Structural model results.

Path	St. Weights	CR	P	Note
H1: Driver Shortage —> Logistics Capability	-0.430	-4.435	<0.001	Supported
H2: Driver Shortage —> Logistics Performance	0.076	0.942	0.346	Not Supported
H3: Logistics Capability —> Logistics Performance	0.715	6.823	<0.001	Supported

Fit statistics: Chi-square = 222.555 (df = 144, p < .001), Chi-square/df (CMIN/DF) = 1.546 CFI = 0.958, RMSEA = 0.058, SRMR = 0.057.

Table 5. Linear regression model results.

Model	Independent variable	Dependent variable	Unstandardized Coefficients		Standardized Coefficients	t-value	p-value
			B	Std. Error	Beta		
1	*Driver Shortage*	*Logistics Capability*	-.226	.049	-.346	-4.652	.000
2	*Driver Shortage*	*Logistics Performance*	-.231	.068	-.260	-3.390	.001
3	*Driver Shortage*	*Logistics Performance*	-.041	.058	-.046	-.704	.482
	Logistics Capability		.837	.089	.617	9.402	.000
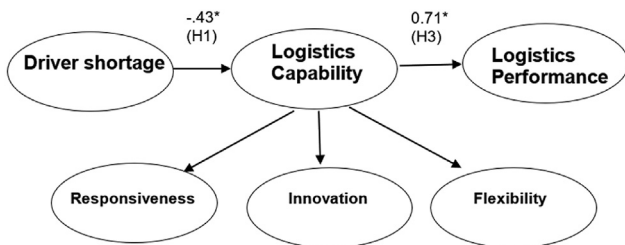
Note: *p-value <.001

Figure 2. Path model. Note: *p-value <.001.

directly influences the service quality and price in LSPs. In addition, the role of LSP is a linkage of their business partners in a supply chain, many benefits that supply chains may achieve from value-added LSP services (Bask, 2001). Moreover, logistics performance is a success factor for LSPs and their customers (Richard and Rein, 2004). Therefore, it is significant to focus on the LSPs to add value to an entire supply chain.

The study indicates that the driver shortage is a vital transportation capacity shortage issue for LSPs as it affects logistics performance, not directly, but through the mediating influence of the three forms of logistics capability. In the modern, highly competitive business environment, logistics outsourcing is not only for achieving low cost but also the use of logistics outsourcing as a strategic tool to build a competitive advantage, increase customer services, achieve sustainability, and mitigate the supply chain uncertainties and risks (Cooper and Ellram, 1993; Esper et al., 2007; Wang et al., 2015). This requires logistics service providers to offer superior logistics performance to accomplish the missions.

6.1. Theoretical implications

This work contributes to theory in logistics management, and we have three theoretical contributions. First, the labor/driver shortage is confirmed as a significant issue in logistics and transportation. This is the first model that incorporates the driver shortage construct and provides the first empirical evidence that suggests that the transportation capacity shortage, i.e., driver shortage, has a real impact on LSPs. Transportation capacity is an essential issue in the transportation and logistics industry (Pellegrino et al., 2020). Based on the RBV, the logistics capability can be applied to mitigate the negative impacts of transportation capacity, such as delays, inadequate operational strength, labor shortage, and optimized logistics operations. With logistics capability as a mediating variable in the model, the full mediation effect links practical transportation capacity issues with RBV. Second, although the concepts of logistics capability and performance have been widely discussed in previous studies, we revisit and develop measurement scales of logistics capability and logistics performance in the LSPs. The results show that logistics capability should embrace innovation, flexibility, and responsiveness in Industry 4.0. The results are in line with recent studies; those capabilities enable organizations to respond to and adapt to both internal and external changes quickly. Although the data were collected from the Australian transportation and logistics companies, the measurements and results may be further validated in different contexts. Third, this study

provides valuable insights into sustainability and transportation capacity management in Industry 4.0; the results stress that transportation capacity, such as a driver shortage, is not just a short-term problem; companies may treat drivers as a strategic asset. Therefore, the logistics capability should be incorporated with strategic assets to improve logistics performance. These findings also provide fruitful insights and implications for policymaking and governance. Governments may invest in logistics capability to overcome some transportation capacity issues; this also explains and supports that new technologies improve logistics capability and enhance logistics performance in Industry 4.0.

6.2. Managerial implications

The paper presents empirical evidence to demonstrate the impacts of driver shortage in the Australian LSPs. The empirical study findings should aid managers in understanding the mechanism that company resources (e.g., drivers, delivery, or capacity) may influence logistics performance. The driver shortage can lead to delays in pickup/delivery, an essential issue in the last mile delivery. The evidence further illustrates that driver shortage may influence the internal operations, customer service, delivery, service quality, and company reputation in the transportation and logistics industry. Managers should be cognizant of the importance of the skilled and qualified personnel/drivers and influence logistics capability logistics performance. As a manager, it is crucial to understand how the driver shortage influences the logistics performance; this also would help the management provide strategic solutions for the caused problems, optimize the existing operations, and improve the availability of carrier capacity. For example, the driver shortage issue has become an important problem in many countries in the post-COVID-19 pandemic. This study provides an idea to maximize the capacity of delivery by deploying logistics capability. In addition, understanding the impacts of driver shortages may help policymakers develop a set of policies and guidance to support the employees, businesses, and industries in the post-COVID-19 pandemic.

As we progress towards an era of reduced reliance on human drivers, moving towards robotic or automated, or autonomous trucks, the impact of the driver shortage may reduce (Wang and Radics, 2019). However, this study still indicates vital importance for the role of people within the system. It is people and their knowledge and experience that drive the capabilities and these capabilities that result in logistics performance. Therefore, even as a firm may consider replacing human drivers with autonomous trucks, they should be careful to selectively ensure some drivers are retained and other staff, with the experience required to help guide the development of future logistics performance. More importantly, the results reveal that customer service plays a vital role in the modern transportation and logistics industry; the LSPs should focus on providing flexible and dedicated logistics services to support their customers.

This study provides insights into transportation capacity management in the LSPs. According to resource-based theory, the study investigates the relationships between the driver shortage, logistics capability, and performance in LSPs. The driver shortage is looming in most OECD countries (Wang and Radics, 2019; Williams et al., 2017). However, a lack of knowledge about how the driver shortage can influence logistics performance results in ineffective and inefficient logistics management.

The results may further help managers generalize some strategic resolutions to overcome the transportation capacity shortage issues in the firms. Such as, innovation capability may help companies resolve the problems by applying new technologies, processes, and business models. Responsiveness capability represents the customer service, allowing LSPs to mitigate the transportation capacity shortage by offering better customer service. Flexibility capability refers to the internal operations; the companies should provide routine services, and flexible delivery scheduling for the customers to overcome the issue. As discussed before, earlier driver shortage studies focus on the causes, recruitment, and work conditions and provide practical and operational resolutions to the driver shortage. This paper sheds light on strategic guidance for practitioners and researchers to manage the relevant transportation capacity issues from an LSPs' perspective. However, further research is needed to validate the specific resolutions in the different cases.

Declarations

Author contribution statement

Michael Wang: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Lincoln C. Wood & Bill Wang: Analyzed and interpreted the data; Wrote the paper.

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The authors do not have permission to share data.

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The authors declare the following conflict of interests: Assoc Prof Lincoln C Wood; Member of the Heliyon Editorial Advisory Board.

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