Evaluating logistics capability for mitigation of supply chain uncertainty and risk in the Australian courier firms

Received 4 November 2014
Revised 1 February 2015
Accepted 1 February 2015

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Abstract

Purpose – Logistics capability is an important ability for transport and logistics firms to deliver the value and services to the customers. In contrast, supply chain uncertainty and risk is an issue in supply chain and logistics to obstruct the delivery. The purpose of this paper is to evaluate and understand the logistics capability, and to provide empirical evidence for logistics capability mitigating supply chain uncertainty and risk in the Australian courier firms.

Design/methodology/approach – This study examines the relationship between logistics capability and supply chain uncertainty and risk. Partial least squares approach for structural equation modelling is applied for data analysis involving the interplay of theoretical thinking and empirical data. Empirical data are collected through a web-based survey. Total 98 Australian courier firms are identified and invited in the study.

Findings – Based on the factor analysis, the authors identify the key factors of logistics capability for the Australian courier firms. This would help both academics and practitioners to have a better understanding of logistics capability in the transport ad logistics firms. In addition, results indicate that there is a negative relationship between logistics capability and supply chain uncertainty and risk in the Australian courier firms.

Research limitations/implications – The result in support of logistics capability mitigating supply chain uncertainty and risk. It also makes a contribution to logistics risk management literature. The paper focuses on the Australian courier industry. Therefore, any generalisation to other countries or sectors must be made with caution.

Originality/value – This paper provides an insight into supply chain uncertainties and risks management. This would result in the development of a practical guidance for practitioners developing and deploying logistics capability to support and enable supply chain risk management strategies.

Keywords Australia, Logistics operations and management, Australia, Courier, Logistics capability, Risk assessment and management, Supply chain uncertainty

Paper type Research paper

Introduction

Supply chain uncertainty and risk has become a popular topic in supply chain management. As market competition for logistics and transport increases, more and more logistics and transport companies try to pursue the operational excellence, so that the company can provide the excellent logistics operations to gain a firm's market share for sustainable development in the long term. One of the obstacles to achieve the operational excellence is supply chain uncertainty and risks. As many researchers urge supply chain risk and uncertainty is an issue in supply chain and logistics (Davis, 1993; Lee, 2002; Miller, 1992; Prater, 2005; Vasco *et al.*, 2010). And the world leading logistics and transport companies (e.g. DHL) also recognise that the supply chain uncertainty and risk may hamper companies to towards the operational excellence. Therefore it is significant to pay attentions to the supply chain uncertainty and risk. Previous studies

Asia Pacific Journal of Marketing and Logistics
Vol. 27 No. 3, 2015
pp. 486-498

1355-5855
DOI 10.1108/APJML-11-2014-0157

focus on supply chain uncertainties and risks (Simangunsong *et al.*, 2012). However lacking of resolution of supply chain uncertainties and risks is a problem, which has also been raised in previous studies (Borut *et al.*, 2012; Guido *et al.*, 2008; Sanchez-Rodrigues *et al.*, 2010; Simangunsong *et al.*, 2012).

Based on resource-based view (RBV), the firms can gain and sustain competitive advantages by developing and deploying valuable resources and capabilities (Wernerfelt, 1984). Capabilities are complex bundles of skills and accumulated knowledge, exercised through organisational processes, which enable firms to coordinate activities and make use of their assets (Day, 1994; Mohamed *et al.*, 2014). In addition, capability is considered as the ability to make use of resource to perform some task or activity and a resource consisting of anything tangible or intangible owned or acquired by a firm (Hafeez *et al.*, 2002).

Courier is a typical third party logistics provider (Cowles, 2012). During the past couple decades, logistics and transport industry is booming worldwide, and the competition in third party logistics market is very intensive. With the rapid development of online shopping, couriers need more attention to their sustainability. Logistics capability qualifies to be a distinctive capability in the integrative strategic process due to the expected benefits of improving firm performance leading to long-term firm profitability and survival (Mentzer *et al.*, 2004).

The paper provides new insight into logistics capability of the third party logistics. This would draw attention to balance and develop firm capabilities for mitigation of supply chain uncertainty and risk in order to achieve business sustainability. There have been very few studies conducted on the courier business. The purpose of this study is to evaluate logistics capability for the Australian courier firms and investigate the relationship between logistics capability and supply chain uncertainty and risk in the Australian courier firms. The relationship may reveal that logistics capability mitigates the supply chain uncertainty and risk. Based on factor analysis, the key underlying factors are identified. Statistical software packages including IBM SPSS version 21 and SmartPLS version 2.0.M3 are used for empirical data analysis. The findings would be generalised and used for both academics and practitioners to develop logistics capability and supply chain risk management in the further research.

Theoretical background

Logistics capability

Logistics capability has become an important concept in supply chain and logistics. The largest scale of study on logistics capability was done by Michigan State University Global Logistics Research Team in 1995. They have chosen 17 general logistics capabilities from 32 possible logistics capabilities into four groups including positioning capability, integration capability, agility capability and measurement capability. Further, logistics capability can be defined from different perspectives.

Innovation capability is an important logistics capability (Fawcett and Stanley, 1997; Hayes *et al.*, 1988; Lu and Yang, 2010; Morash, 2001; Morash *et al.*, 1997). It is defined as the firm's ability to continuously transform knowledge and ideas into new products, processes and systems for the benefit of the firm (Lawson and Samson, 2001; Yang, 2012). The rapidly changing market makes enterprises face the biggest challenge, innovation is one of the important tools for enterprise to keep their competitive advantage (Lin, 2006).

Customer service is an important firm ability to deliver better responsiveness, which is a critical logistics capability to response markets. Responsiveness is the

accommodation of unique and/or unplanned customer requirements (Morash *et al.*, 1997; Zhao *et al.*, 2001). Organisation should become more customer oriented by identifying and building the customer emphasis capability (Day, 1994; Zhao *et al.*, 2001). In addition, customer service is considered as an important logistics capability (Lu and Yang, 2010; Kim, 2006; Zhao *et al.* 2001). Both customer service and responsiveness are related to firm performance (Zhao *et al.*, 2001).

It has been widely recognised that flexibility is an important firm capability in logistics and supply chain (Prater *et al.*, 2001). Flexibility reflects an organisation's ability to effectively adapt or respond to change (Mark and Martin, 2007; Naim *et al.*, 2010; Prater *et al.*, 2001; Vickery *et al.*, 1999). Flexibility is considered as adaptation to unexpected operational circumstance (Zhao *et al.*, 2001). Further, logistics capability is an important ability of control and responding to unexpected events or supply chain disruptions (Gligor and Holcomb, 2012; Peck, 2006; Serhiy and Mary, 2009). Therefore, flexibility is one of the key attributes of logistics capability in this study.

Overall, the following attributes of logistics capability consisting of innovation, flexibility, information technology/process, are considered for the logistics capability assessment in the study. The previous studies are shown in Table I.

Supply chain uncertainty and risk

There are many different ways to define the concept of risk and uncertainty. Therefore, it is significant to consider the uncertainty and risk in a specific context. This study concentrates supply chain uncertainty and risk in logistics and transport context. Although supply chain uncertainties and risks are similar (Simangunsong *et al.*, 2012), there are some differences between supply chain uncertainty and risk in a deeper level analysis. This paper does not focus on distinguishing the uncertainty and risk. Instead, the research considers the ways to mitigate the negative impacts of supply chain uncertainty and risk simultaneously without separate them. Supply chain uncertainty is often used interchangeably in practice with the term – supply chain risk (Peck, 2006). For managers, risk is a threat that something might happen to disrupt normal activities

Logistics capability	Attributes	Previous research
Innovation	Innovation in service Innovation solution Advanced packaging technology Process improvement Creative techniques	Morash (2001), Hayes *et al.* (1988), Morash (2001), Lu and Yang (2010), Daniel and Fredrik (2011), Kim (2006), Jay *et al.* (2008)
Flexibility	Operation flexible Physical supply flexibility On-time delivery Delivery time flexibility Volume flexibility Location flexibility	Morash (2001), Hayes *et al.* (1988), Fawcett and Stanley (1997), Lu and Yang (2010), Day (1994), Zhang *et al.* (2005), Jay Joong-Kun *et al.* (2008)
IT/process	Customer service Integrated information system Advanced problem notification Protection for freight safety Advanced technology Tracking and tracing	Morash (2001), Lai *et al.* (2004), Zhao *et al.* (2001), Lu and Yang (2010)

Table I.
Logistics capability in previous research

or stop things happening as planned (Waters, 2011). In a real world environment, the managers have to deal with both supply chain uncertainty and risk simultaneously.

Risks occur because people never know exactly what will happen in the future. People can use the best forecasts and do every possible analysis, but there is always uncertainty about future events. It is this uncertainty that brings risks (Waters, 2011). Supply chain uncertainty and risk are complex notions that may come in different forms and may comprise supply chain uncertainty and risk sources, consequences and drivers (Christopher and Lee, 2004; Jüttner *et al.*, 2003; Manuj and Mentzer, 2008; Rodrigues *et al.*, 2008). In supply chain risk management literature, risk is unreliable and uncertain resources creating supply chain interruption, whereas uncertainty is matching risk between supply and demand in supply chain and logistics processes (Tang and Nurmaya Musa, 2011). Technically, although risk and uncertainty are two different concepts (Knight, 1921; Peck, 2006; Rodrigues *et al.*, 2010; Sanchez-Rodrigues *et al.*, 2008; Simangunsong *et al.*, 2012), supply chain uncertainty and risk is defined as the impacts, consequences, unexpected events and/or errors (e.g. delays, damages and loss) may harm the logistics operations in this study.

Measurement model of supply chain uncertainty and risk is adopted from a recent study Wang *et al.* (2014). The supply chain uncertainty and risk are categorised into the following clusters: first, company-side uncertainty and risk; second, customer-side uncertainty and risk; and third, environment uncertainty and risk. The three types of supply chain uncertainty and risk include most uncertainties and risks in the Australian courier firms.

Research hypothesis

Logistics capability has been widely discussed previously, it may improve logistics operations, and an effective logistics operation may generate a competitive advantage for a firm and gain a firm's market share (Scott, 2009). Therefore, logistics capability may help companies to mitigate supply chain uncertainty and risk through excellent logistics operations. Seeking perfection is one of key principles of operational excellence. This paper proposes an idea to implement logistics capability to seek perfection based on RBV. This may achieve excellent logistics operations in order to mitigate the supply chain uncertainty and risk. Because supply chain uncertainty and risk mainly reflect the negative impacts on logistics operational performance, such as delays, damage and loss (Sanchez-Rodrigues *et al.*, 2010). Excellent logistics operations may mitigate these impacts. And logistics capability plays a distinctive role in the integrative strategic process due to the expected benefits of improving firm efficiency and effectiveness leading to long-term firm profitability and survival (Mentzer *et al.*, 2004). A firm has to establish logistics capabilities focusing on delivery speed, quality service, flexibility, cost and innovation in order to achieve optimal operations performance (Fawcett and Stanley, 1997). Moreover, logistics and transport firms require a high level of logistics capability to carry out the outcome of delivery and meet customer's needs. Another reason logistics capability is considered to be used for mitigating supply chain uncertainty and risk, when the external environment is unstable, a firm's internal resources and capabilities may be easier to control (Grant, 1991). Furthermore, Chopra and Sodhi (2004) suggested that increase capability can be used as a risk mitigation approach. As mentioned previously, this study focuses on the Australian courier firms. Therefore, we propose a hypothesis is that there is a negative association between logistics capability and supply chain uncertainty and risk in the Australian courier firms.

Methodology

This section presents the sample design, data collection and measurement used to conduct the research. Total 98 courier firms are identified and invited to participate the study in Australia. For the data analysis, SPSS exploratory factor analysis (EFA) procedure is reported accordingly. The 25-item measures are identified and used to evaluate logistics capability for courier firms. And then we use partial least squares approach for structural equation modelling (PLS-SEM) to investigate the relationship between the logistics capability and supply chain uncertainty and risk.

Sample design

Purposive sampling is used in this study. It is defined as selecting a sample in a systematic or purposive way, based on what we know about our target population and the purpose of study (Walter, 2013). In this paper, a survey population was selected from the Australian business register online and yellow page online. The practitioners, who work in the Australian courier industry, have been approached by e-mails and telephone calls. Overall, 75 per cent of respondents hold management positions including senior managers, operations managers and supervisors. 18 per cent of respondents were company employees including customer service, sales and operations staff and 7 per cent of respondents were independent contractors including truck drivers and couriers.

Sample size is one of critical factors, which may affect the results in a research. More confidence can be placed in the generalisability of statistics from larger sample size (Grinnell and Unrau, 2011). Basically, the larger a sample, the more likely it is that a computed correlation coefficient will be found to be statistically significant (Bryman and Bell, 2011). However, a large sample cannot guarantee precision, so that it is probably better to say that increasing the size of a sample increases the likely precision of a sample. This means that, as sample size increases, sampling error decreases. Therefore the less sampling error one is prepared to tolerate (Bryman and Bell, 2007; Walter, 2013).

In this study, we consider the sample size for research using PLS-SEM analysis; one of the advantages of the PLS-SEM approach is the smaller sample size compared to other approaches. The sample size requirements of PLS-SEM, using the general rule of thumb of ten times per predictor, ten times the largest number of predictors leading to an endogenous (Ashill, 2011; Barclay *et al.*, 1995). With these guidelines above, the valid sample size of this study is 140 respondents.

Data collection

The empirical evidence is collected from the courier firms in Australia. There are five states and three territories in Australia. In order to improve the effectiveness and efficiency of data collection, web-based survey is chosen as the main data collection instrument in the study. The participators can access the questionnaire via the internet 24/7. It provides greater flexibility for practitioners to answer the questions. Information on the respondents is given in Table II. The cases with any missing values are excluded from analysis. 167 valid questionnaires are used for data analysis, and the response rate is 20 per cent.

Measurement

Measures of logistics capability and supply chain uncertainty and risk in this paper are derived from previous research. In order to ensure their content validity, a pilot study is

conducted to test the questionnaire before conducting a comprehensive survey. It was discussed with five managers from Australia's leading courier firms and four academics. The 14-item measures are identified to assess the logistics capability and 13-item measures are used to assess the supply chain uncertainty and risk in a survey (Table III). The questionnaire is structured and presented on a seven-point Likert scale.

Metric	Number	%
Victoria	66	40
New South Wales	42	25
South Australia	11	7
Queensland	15	9
Western Australia	13	8
Tasmania	6	4
Northern Territory	8	5
Australian Capital Territory	6	4
Total	167	100

Table II. Profile of respondents in Australia

Measure	Mean	SD
Logistics capability		
1. My firm applies creative techniques in freight movement and distribution	5.83	1.134
2. My firm regularly improves operational systems	5.72	1.143
3. My firm adopts technologies and innovative solutions for problem solving	5.81	1.224
4. My firm provides a parcel tracing service	6.09	1.362
5. My firm applies simplification of operations	5.78	1.173
6. My firm applies standardisation of operations	5.91	1.091
7. My firm applies protection for freight safety and risk	6.09	1.032
8. My firm's service flexibility is capable to meet customers' needs	6.15	0.798
9. My firm is capable to keep low-freight damage/loss rate	6.03	0.935
10. My firm is capable to maintain consistent on-time delivery for all customers	5.90	0.903
11. My firm offers customised logistics services	6.06	1.059
12. My firm is capable to handle problems and complaints	6.28	0.758
13. My firm has flexible delivery scheduling and routing	5.92	1.142
14. My firm has extensive operation hours (e.g. after hours delivery)	5.59	1.363
Supply chain uncertainty and risk		
1. Inadequate operational strength (e.g. poor fleet/delivery capacity)	2.31	0.98
2. Storage issues (e.g. school/company closed, temperature control)	2.28	1.10
3. Delays in pickup/delivery	2.49	1.15
4. Poor communication between company and drivers	2.33	1.33
5. Poor information sharing within company	2.32	0.87
6. Delays due to customer's mistakes (e.g. not home, incorrect dangerous goods paperwork)	2.77	0.97
7. Customers changing the preference	2.31	1.12
8. Inaccurate forecast of customers' freight volume	2.38	1.10
9. Labour/driver shortage	2.42	1.40
10. Road congestion/closures	2.72	1.29
11. Weather/natural disasters/industrial action (e.g. bushfire, strike)	2.25	1.07
12. Unstable fuel prices	2.56	1.12
13. Uncertainty due to government laws/regulation (e.g. import fee increased)	2.41	1.03

Table III. Scales and summary statistics

Rensis Likert developed the scale in 1932. Likert-type scales are considered as reliable and are recommended for obtaining people's attitudes, values and perceptions. It allows the individuals to make a decision based on the level of agreement. This is a common format for assessing participants' opinions of usability. In the seven-point Likert-type scale used in this study the value "1" represents "Strongly disagree" and the value "7" represents "Strongly agree". Means and standard deviation for each item are shown in Table III.

Considering the measures of logistics capability, this research measures respondents' opinions. The participants are asked to rate how they consider logistics capability in their firms compared to competitors in terms of the six attributes. The measures were adopted from previous studies. The reliability and validity are assessed, respectively. EFA is used to generate reliable and accurate scales including valid factors for evaluating logistics capability in the Australian courier firms. EFA is an exploratory technique to determine the factors without knowing factors beforehand (Hair, 2010). Although measures of supply chain uncertainty and risk are adopted form a recent study Wang *et al.* (2014), confirmatory factor analysis (CFA) is used to examine the *t*-values of the measurement model loading in this study.

Data analysis and results

Based on the results of the comprehensive survey, EFA is performed to explore underlying factors of logistics capability based on the empirical evidence from the Australian courier firms. And then we conduct CFA to assess both measurement models of logistics capability and supply chain uncertainty and risk by using structural equation modelling software SmartPLS.

EFA

The EFA is used to evaluate the logistics capability in the Australian courier firms. We use IBM SPSS Statistics Version 22 to conduct the factor analysis. The SPSS software offers five rotation methods: varimax, direct oblimin, quartimax, equamax and promax, in that order. Three of those are orthogonal (varimax, quartimax and equimax), and two are oblique (direct oblimin and promax). To choose the two rotation methods that is based on the whether the factors are believed to be correlated (oblique) or uncorrelated (orthogonal) (Vogt, 1993). Gorsuch (1983) suggested varimax method should be used for orthogonal or promax method should be used for oblique. Therefore, principal axis factoring with promax method is used to explore the factors, a minimum eigenvalue of 1 were chosen as conditions for factor extraction. Items were allocated to a factor if their primary loading was greater than 0.5, if they did not cross-load onto more than one factor and if their communality is greater than 0.4. Overall, the logistics capability statistics is summarised in Table IV.

Item reliability and validity

The measurement was tested for its reliability and validity. Reliability is an assessment of the degree of consistency between multiple measurements of a variable (Hair, 2010). This study applies reliability coefficient with Cronbach's α to test the reliability of the scale. The reliability is demonstrated by Cronbach's α greater than 0.7 in SPSS (Hair, 2010). Results indicate the logistics capability measurement has a high level of reliability.

	Logistics capability	References (Hair, 2010)	Requirement met (Y/N)
Cronbach's α	0.905	> 0.7	Yes
Communalities	> 0.70	> 0.5	Yes
Visual analysis of correlation	> 0.3	> 0.3	Yes
KMO	0.865	> 0.50	Yes
Barlett's test (sig.)	0	0	Yes
Eigenvalues included	> 1	> 1	Yes
Cumulative %	6.319	> 60	Yes
Number of factors	3	n/a	Yes
Discriminate validity	< 0.7	< 0.7	Yes
Convergent validity	> 0.7	> 0.7	Yes

Table IV. The logistics capability statistics

Validity is an important dimension to indicate the degree of accuracy of measurements. Face/content validity are tested in a pilot study. This section examines both convergent validity and discriminant validity. Convergent validity assesses the degree to which two measures of the same concept are correlated (Hair, 2010). High correlations are required to ensure the convergent validity, great than 0.7 is considered as a satisfaction level. In contrast, discriminant validity is the degree to which two conceptually similar concepts are distinct (Hair, 2010). Convergent validity is demonstrated by loadings greater than 0.700, average variance extracted (AVE) greater than 0.500, and communalities greater than 0.500. Discriminant validity is demonstrated by the square root of the AVE being greater than any of the inter-construct correlations (Hair, 2012).

According to the EFA, three underlying factors are extracted from logistics capability. They are operation flexibility-focused capability, innovation-focused capability (IC) and process optimisation-focused capability (PC). Overall, the logistics capability measurement is summarised in Table V.

Structural model

The PLS Path model is presented in Figure 1. The estimation of the structural relationships in the model was conducted by using a bootstrap routine with 1,000 iterations. The bootstrapping sample relates to significances of $p < 0.1$ for $t > 1.65$, $p < 0.05$ for $t > 1.96$ and $p < 0.001$ for $t > 2.58$ (Hair, 2010). A confidence interval indicates how reliable survey results are. In applied practice, confidence intervals are typically stated at the 95 per cent confidence level ($p < 0.05$ for $t > 1.96$) (Zar, 1984).

A path coefficient is used for hypotheses testing in the paper. The standardised path estimates (β) represent the strength, direction and significance of the relationship between constructs. β is considered to be large, medium and small for values of greater than 0.37, 0.24 and 0.1, respectively. Absolute value of a path coefficient should be not greater than 1. Negative value stands for the negative relationship between two concepts. Positive value stands for the positive relationship. According to the empirical data analysis, $\beta = -0.446/t = 5.68$, there is a negative relationship between logistics capability and supply chain uncertainty and risk. The hypothesis in this study is supported. In addition, this study provides empirical evidence in support of an idea to implement logistics capability for mitigating supply chain uncertainty and risk in the Australian courier firms.

Factor	Measure	Cronbach's α	Mean
Operation flexibility -focused capability(FC)	*FC-1*: my firm offers customised logistics services *FC-2*: my company has flexible delivery scheduling and routing *FC-3*: my firm has extensive operation hours *FC-4*: my firm's service flexibility is capable to meet customers' needs *FC-5*: my firm is capable to maintain consistent on-time delivery for all customers *FC-6*: my firm is capable to keep low-freight damage/loss rate	0.799	5.9
Innovation-focused capability (IC)	*IC-1*: my firm applies creative techniques in freight movement and distribution *IC-2*: my firm regularly improves operational systems *IC-3*: my firm adopts technologies and innovative solutions for problem solving	0.848	5.7
Process optimisation-focused capability (PC)	*PC-1*: my firm applies simplification of operations *PC-2*: my firm applies standardisation of operations *PC-3*: my firm applies protection for freight safety and risk *PC-4*: my firm is capable to handle problems and complaints *PC-5*: my firm provides a parcel tracing service	0.819	6.0

Table V.
Summary of logistics capability measurement

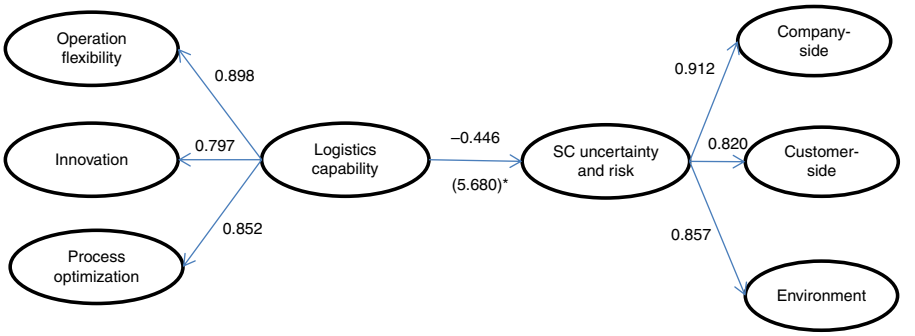

Figure 1.
Path model

Note: *$p < 0.001$

Discussion and conclusion

The results of this study provide important empirical evidence that logistics capability mitigates supply chain uncertainty and risk in the Australian courier firms. Table V summarises the factors of logistics capability including operation flexibility-focused capability, IC and PC. In this study, PC is defined as a firm's ability to optimise the business processes in order to provide better logistics-related services for both internal and external customers. Operation flexibility-oriented capability (FC) is defined as a firm's ability to provide better logistics-related services by improving the flexibility.

And IC is defined as a firm's ability to continuously implement new technology and ideas into daily operations of a business.

IC has the lowest average mean value. PC capability has the highest average mean value. Although results reflect that the Australian courier firms have a relatively high-level logistics capability, this implies that the Australian courier firms should promote IC. It has become an important capability to influence the logistics performance in logistics and transport (Daniel and Fredrik, 2011).

The factors of logistics capability are closely related to each other in firms. It is significant to consider them as an entity to influence the supply chain uncertainty and risk. In addition, supply chain uncertainty and risk often occur simultaneously in a firm. Therefore, we test a direct relationship between the two constructs. This sufficiently supports the idea of RBV approach for mitigating supply chain uncertainty and risk by deploying and developing logistics capability in the Australian courier firms.

There are very few research conducted on courier business. With the rapid development of online shopping, courier has become an important and unique transport model for delivering small and medium packages/parcels. It provides a fast, secure and convenient door to door delivery for both individuals and businesses. The research findings closely associated with courier businesses. It provides new insight into development of a practical guidance for mangers deploying and developing logistics capability in order to mitigate supply chain uncertainty and risk in courier industry. In addition, it may draw attention to courier studies. This would result in increased effectiveness and efficiency of management behaviour in courier businesses.

This paper provides a contribution to logistics risk management literature. The results reveal the underlying factors of the logistics capability based on the empirical evidence from the courier firms, and the logistics capability is significantly associated with supply chain uncertainty and risk. The research conducted on the courier firms in Australia. Thus, any generalisation to other countries, industries or sectors must be made with caution. The measurement may be used to assess logistics capability and supply chain uncertainty and risk in the different context. The idea may be developed by examining different types of firm capabilities in different industries and/or countries.

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