

Concept Paper

Logistics Innovation in China: The Lens of Chinese Daoism

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Abstract: Innovation is vital for the logistics industry. This paper develops a Daoism-based conceptual model for logistics innovation in China. It identifies research gaps in this area and provides directions for future research. Following a content-based literature review methodology, 45 studies were selected. We identified five research themes: interpretation of logistics innovation; Chinese institutional environment for logistics innovation; innovation generation; innovation adoption; and innovation capability. We integrate the process view and outcome view of logistics innovation and propose that logistics capability, as an innovation outcome, is reflected and measured by innovation generation and adoption. This study is probably one of the first conceptual development papers on logistics innovation in China, providing a model for innovation within this context. It provides new avenues of research in this emerging, albeit important, area of research. Our conceptual framework utilizes Chinese Daoism philosophical thinking to provide a new lens for logistics innovation that is sensitive to the cultural environment.

Keywords: logistics innovation; China; conceptual development; innovation capability; Daoism

1. Introduction

Over four decades of economic development in China, the Chinese logistics industry has undergone accelerating development. As the Chinese National Development and Reform Commission (NDRC, [1]) states, in 2017 the total value of China's logistics industry was 252.8 trillion Yuan (approximately USD1 = RMB6.5), around 6.8% more than in 2016. The total logistics costs in 2017 amounted to 12.1 trillion Yuan, a year-on-year increase of 9.2%. The ratio of total logistics costs to gross domestic product (GDP) was 14.6%, a 0.3% decrease from 2016 [1].

Compared with other countries, logistics has been a priority industry in China's economic development. According to the 'Medium and long-term development of logistics industry planning (2014–2020)', the logistics industry is "fundamental and strategic to the country's economic development" [2].

China's entry into the World Trade Organization (WTO) at the end of 2001 boosted the country's logistics industry. Although the speed of its logistics development slowed down from a double-digit level to 6.7% in 2015, overall it has shown a higher growth rate than the level of GDP growth most of the time. However, China's total logistics costs remain high and the ratio of logistics costs to GDP remains almost double that of many developed countries [3].

A highly fragmented logistics market and a low penetration of third-party logistics (3PLs or TPLs) are two reasons for China's high logistics costs [4]. Further, China has a slow adoption rate for

new technologies, exacerbating the situation [5]. While some customers (retailers and manufacturers) complain about lack of innovation with regard to 3PLs, other customers try to squeeze the profit margin of 3PLs, making innovation even more difficult—although all parties realize that it is important for logistics providers to provide value-added service to their customers and ensure the efficiency of the supply chain.

To survive in such fierce competition, logistics companies need to search constantly for new ways to serve their clients and improve their service quality [6], especially as the Chinese economy has now entered a ‘new norm’ of slower economic growth. These firms need to differentiate themselves through innovation and to provide customized services to fulfil even more complex customer needs [7].

Logistics and supply chain researchers have recognized the importance of the national culture in the buyer–supplier relationship [8]. Zhao et al. [9] call for research on the effect of *guanxi* (an informal network based on kinship and friends) on buyer–supplier relationships in China. Lai et al. [10] propose more cross-cultural investigation of the moderating effects of culture on the effects of power on relationship commitment and supply chain integration. Miao et al. [11] suggest that organizational culture is positively associated with firms’ social responsibility. Barney et al. [12] conclude that national cultures and philosophical inspiration such as Daoism, Confucianism, Hinduism, and Buddhism have a specific moderating or mediating role on innovation and which lead to the differentiation between countries and regional ecologies.

Given the importance of logistics innovation, this paper aims to develop an integrated conceptual model by conducting a content-based literature review of this topic in China for the following reasons: first, the rapid development in China’s logistics industry provides many opportunities for innovation. It has taken China only around 40 years to achieve the level of accomplishment in industrialization that took developed countries 100 years [13]. Hence, China can be a large-scale laboratory for logistics innovation. Second, China has been the largest manufacturing base in the world for many years and is a rapidly developing consumer market; therefore, Chinese logistics practices have a significant influence on the effectiveness and efficiency of global supply chains [14,15]. Last, we answer the call by Liu and Mckinnon [16] to create China-based supply chain management knowledge because China has a different institutional environment and faces different supply chain challenges (e.g., economic, political, and cultural) from those of the West. There are hardly any reviews on logistics innovation in general [17,18] and there are none specifically for China. This situation provides an excellent opportunity for applying, extending, and challenging existing theories and frameworks that have been developed in the West [19].

In particular, this study pays attention to the Chinese philosophy of Daoism, as “contemporary Chinese business life reflects more the philosophy of Daoism rather than Confucianism” [20] (p. 439). Daoism says, “The things of the world arise from being. And being arises from nothing” (Dao-de-jing Chapter 40) [21]. This plays an important role shaping logistics innovation in China. For example, Birkin et al. [22] find that new sustainable business models can be generated from the traditional Chinese cultural approach, such as Daoism. Sabelli [23] claims that Daoism highlights the co-existence of opposites (e.g., harmony and conflict, existence and non-existence, union, and separation); interacting opposites co-create novelty, complexity and diversity; opposites are complementary and can be unionized. This is also called the Yin-Yang principle, a Chinese form of dualism, which argues that two states co-exist in harmony and can be in transition from Yin to Yang (and vice versa) all the time [24], which can potentially be applied to the relationship between innovation generation and innovation adoption.

Based on the above arguments, we believe that a systematic literature review is therefore needed to synthesize the research that has already been conducted and to provide directions for future research. This research aims to answer the research questions:

- What are the research themes in logistics innovation in China?
- How can the Chinese philosophy of Daoism be applied to logistics innovation in China?
- What are the future research directions for logistics innovation in China?

The remainder of this paper is arranged as follows. We begin by presenting our literature review and then we report the descriptive results. Next, we analyze the extracted logistics innovation themes and follow this with a proposed conceptual model of logistics innovation built on the traditional Chinese philosophy of Daoism, as well as presenting a discussion of future research direction. Finally, we provide a conclusion on the implications and limitations of this research.

2. Review Method

To identify the papers on logistics innovation in China, we adopted a content-based literature review method [25]. A content-based literature review applies content analysis tools and is considered a branch of systematic literature reviews [26]. The dimensions and analytic categories can be deductive (based on theories) or inductive (based on reviewed material). We adopted a framework combining key constructs from Grawe [17] and Busse and Wallenburg [18] following a deductive approach and then revised the initial framework with the themes inductively identified from the reviewed papers. Finally, we proposed a conceptual framework for logistics innovation in China.

To specify the scope of the review, we defined the boundaries. For a definition of ‘China’, we followed Cui et al. [27] and Liu [28], which indicated the Great China Region covering mainland China, Hong Kong and Taiwan (since the latter two are closely linked to mainland China historically, culturally and economically). Logistics are the activities between customers and suppliers that are involved in the flow of products, service and information from the point of origin to the point of consumption [29]. This includes the traditional logistics services such as transportation and warehousing, as well as value-added services such as vendor management inventory and logistics information tracking. Logistics innovation includes all logistics-related innovations. These can be innovations by the logistics industry or other industries, logistics service users or logistics providers, as long as the innovations have a direct influence on logistics activities [30]. We adopted this definition of logistics innovation in this paper.

To begin the review process, three sets of keywords were identified for logistics, innovation and China, respectively. Since the terms ‘logistics’ and ‘China’ are relatively straightforward, the keywords applied were ‘logistics’ and ‘China/Chinese/Taiwan/Taiwanese/Hong Kong’. As ‘innovation’ is a broad term, the keywords used were ‘innovat*/change/evolut*/trend/develop*/improv*/solution*’.

‘EBSCO’ and ‘Scopus’ were applied as the search engines. These databases were selected because of their broad coverage of management and engineering journals and their wide accessibility by worldwide library systems. In addition, they have been widely applied in other logistics and supply chain literature reviews. To be comprehensive, we did not apply a beginning year or specify the journals; rather, we specified peer-reviewed papers published in English language journals, to the end of 2016 and with a focus on logistics innovation in the Great China Region.

After entering the three sets of keywords in the two databases, under ‘Abstract or Author-applied abstract’ in EBSCO and ‘Abstract, title and keywords’ in Scopus, we found 413 and 526 returns, respectively. We first read the abstract, title and keywords for each paper, to check its relevance. There was some degree of overlap between the two databases in terms of papers identified and in total, 70 papers remained after this round of screening and merging. We then read the full text of the 70 papers and also checked their references for any further relevant papers that had not been identified by the search engines. This process resulted in 45 papers that met all of the inclusion criteria for the final review (see Figure 1 for the review process and Table 1 for the inclusion and exclusion criteria). A full list of the selected papers can be found in the Appendix A, classified by author name, year of publication, journal name and innovation categories.

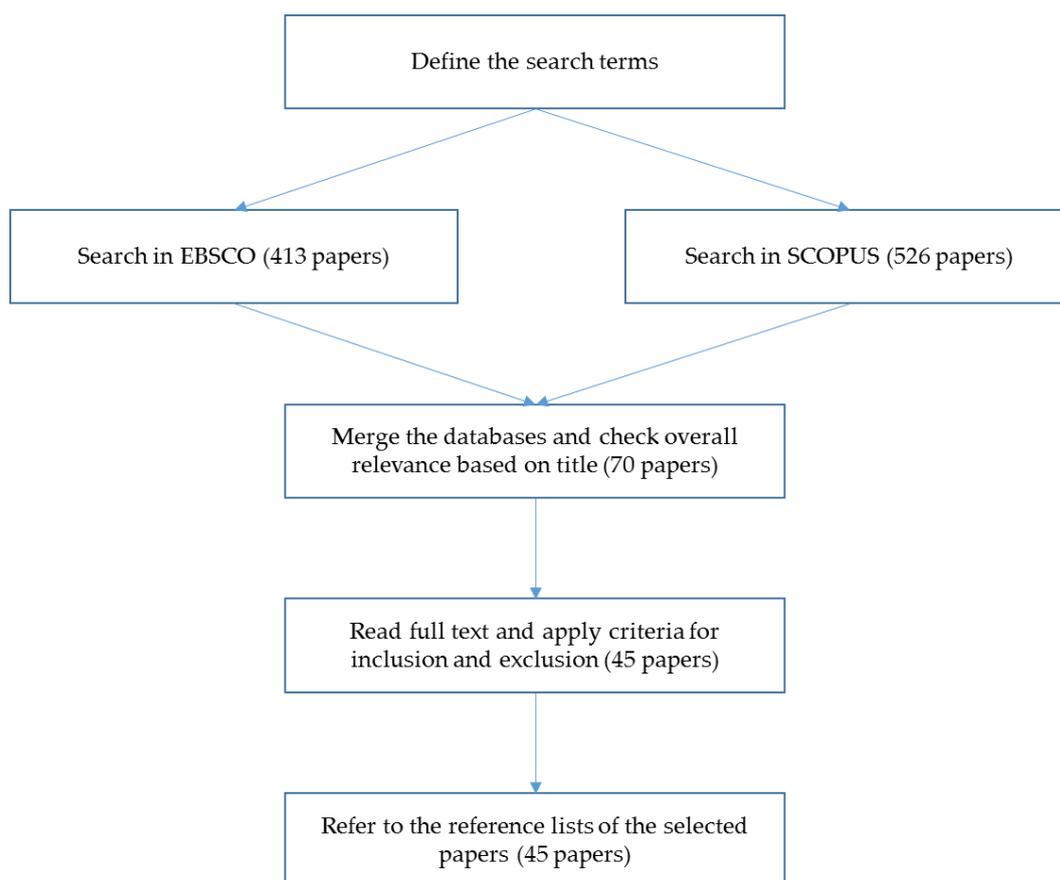


Figure 1. Literature review process.

Table 1. Inclusion and exclusion criteria in the systematic literature review.

Inclusion Criteria	Exclusion Rationale
Focused on logistics innovation	Innovations not related to logistics
Focused on mainland China, Taiwan, Hong Kong (Greater China Region)	Logistics innovations in other regions
Peer-reviewed journal paper in English	Non-English language journals
An open time frame	

In addition, we consulted ‘grey literature’ such as industry reports (e.g., Fung Business Intelligence Centre [3] and Maersk Technical Report [4]). Literature reviews on logistics innovation in general were carefully examined as well, such as Grawe [17] and Busse and Wallenburg [18]. We use these documents as a point of reference in the discussion section.

3. Descriptive Analysis

This section presents a descriptive analysis of the 45 selected papers, including analysis of the distribution of papers by year of publication, number of papers published by the key journals, top authors, geographical region coverage, industry focus and research methodologies adopted. Figure 2 shows the distribution of papers by year, indicating that the number of papers published before 2009 generally increased. The first publication identified was published in 2002, while in 2008 and 2009, the annual number of papers reached a peak of six. After that, the number of publications stabilized at between three and five papers annually, with an exception in 2013, with only one paper.

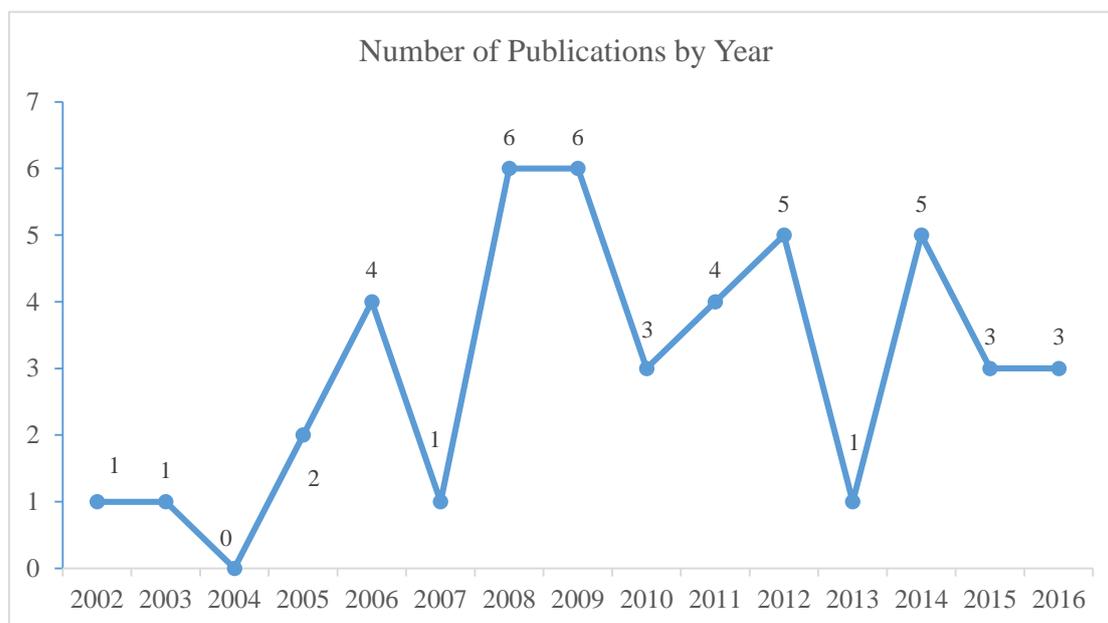


Figure 2. Number of publications by year (N = 45).

Table 2 shows the distribution of papers by journals. In total, 28 journals published on the topic of logistics innovation in China, which shows a highly scattered distribution. International Journal of Production Economics (IJPE) has the highest number of publications with six been found, follow by International Journal of Physical Distribution & Logistics Management (IJPDLM), and Transportation Journal (TJ) have the second highest number of publications with each publishing four. Two papers each were published by six journals and the remaining 19 journals have published one publication each.

Table 2. Number of publications by journals.

Journal Title	Number of Publications
International Journal of Production Economics (IJPE)	6
International Journal of Physical Distribution & Logistics Management (IJPDLM)	4
Transportation Journal (TJ)	4
The International Journal of Logistics Management (IJLM)	2
International Journal of Logistics: Research and Applications (IJLRA)	2
International Journal of Production Research (IJPR)	2
Journal of Technology Management & Innovation (JTMI)	2
Supply Chain Management: An International Journal (SCMIJ)	2
Transportation Research Part E (TRPE)	2
Others (19)	1
Total	45

The key authors in this field were ranked in terms of their number of contributions made in the journals, as shown in Table 3. In total, 80 authors had contributed to this research topic. Of the top nine authors, only one (Nachiappan Subramanian) was based in mainland China; four were affiliated to Taiwanese universities (Chieh-Yu Lin, Yi-Hui Ho, Shong-lee Ivan Su and Ching-Chiao Yang); two were affiliated to Swedish universities (Liangang Cui and Susanne Hertz); and two were affiliated to Hong Kong universities (Kee-hung Lai and T.C.E. Cheng). Thus, it seemed that Taiwanese scholars and overseas Chinese were predominant in this research area. These authors were fluent in both English and Chinese, therefore having the advantage of understanding the Chinese context.

Table 3. Number of publications by authors.

Author Name	Number of Publications
Chieh-Yu Lin	10
Yi-Hui Ho	5
T.C.E. Cheng	4
Shong-Iee Su	4
Liangang Cui	3
Susanne Hertz	3
Kee-hung Lai	3
Nachiappan Subramanian	3
Ching-Chiao Yang	3
Others (71)	< 3

In terms of geographic coverage of the papers, 21 out of the 45 papers focused on mainland China, 15 on Taiwan, four on Hong Kong and five on a comparison between different regions within China or between China and other countries. The predominance of Taiwanese scholars meant it was not surprising that mainland China and Taiwan received a similar amount of attention (21 papers vs. 15). Taiwanese scholars' interests are not confined to Taiwan but also to mainland China.

In terms of industry coverage, the majority of papers (34) were focused on the logistics industry, with the rest focusing on logistics issues in manufacturing, electronic manufacturing, computer, communications, consumer electronics and the high-tech, hospital, pharmaceutical and publishing industries.

In terms of the research method adopted in these papers, 33 (73.3%) papers applied a survey method; seven applied a case study method; two applied a mixed method of survey plus case study and modelling plus case study; two applied archival data; and one used another quantitative method. It seemed that researchers tended to favor the survey method when conducting research in logistics innovation in China.

From the reviewed papers, we found that research in logistics innovation in China was still in an early stage, having only started just over a decade ago and with a limited number of key authors contributing to this emerging body of research topic. The number of papers published per year was rising slowly. We found that a similar number of papers focused on mainland China and Taiwan. It is surprising that this topic had not attracted more attention from scholars based in mainland China. The publications were mainly focused narrowly on the logistics industry, with few papers dealing with other industries.

4. Key Themes from the Review

This section reports the themes identified for logistics innovation in China. We developed the themes base on two previous reviews on logistics innovation literature. Grawe [17] analyses logistics innovation around three themes of antecedents, outcomes and diffusion of logistics innovation; and Busse and Wallenburg [18] separate logistics innovation into two overarching classifications: innovation management system (inputs management, knowledge management, innovation strategy, work environment, portfolio management, project management, commercialization) and innovation management processes (innovation generation, innovation adoption). These two studies use systematic literature review methods to explore logistics innovation in general and are more comprehensive than other reviews of logistics innovation, such as Flint [30] and Chapman et al. [31]. Thus, they provided a solid foundation for this research.

To guide our analysis, we combined the results of the two existing literature review papers and developed this into a new framework. We adopted the innovation management processes theme of innovation generation and innovation adoption [18], and the subthemes of antecedents and outcomes of innovation [17]. Inductively, we found three new themes: interpretation of logistics innovation, institutional environment of logistics innovation and innovation capability.

Finally, we classified the 45 papers into five research themes, which form the basis for the subsequent sections of this part of the paper. Section 4.1 provides an interpretation of logistics innovation based on the review of the 45 papers. Section 4.2 discusses the institutional environment of general logistics innovation (the subject of nine papers). Section 4.3 focuses on innovation generation (the subject of three papers). Section 4.4 focuses on innovation adoption (the subject of 23 papers) and Section 4.5 focuses on logistics innovation capability (the subject of ten papers). In addition, the Appendix A provides a detailed classification of the themes of Section 4.2 to Section 4.5.

4.1. Interpretation of Logistics Innovation

The interpretation of logistics innovation included definitions and classification with regard to logistics innovation. Definitions for logistics innovation could only be found in Cui et al. [27,32] for the papers reviewed, which adopted the definition by Flint et al. [30] (p. 114) that logistics innovation is “any logistics related service from the basic to the complex that is seen as new and helpful to a particular focal audience”. The rest of the papers either applied traditional innovation definitions or did not provide any definition. The definitions we reviewed could be classified broadly into three types: innovation generation; innovation adoption; and innovation generation and adoption.

In addition to these mainstream views on innovation, a capability view of innovation has emerged in recent years. For example, Daugherty et al. [15] (p. 30) define logistics service innovation capability as “a firm’s ability to develop new innovative logistics services”. Yang et al. [33] (p. 6) argue that innovation can be regarded as “an organizational capability because it is the act that deploys resources with a new ability to create value”. Innovation capability refers to a firm’s ability to transform knowledge and ideas continuously into new products, processes, and systems for the benefit of the firm [34]. Liu et al. [35] (p. 852) treat innovation as a firm-specific capability, saying, “it is the ability to develop anything new to facilitate the company’s business, operation and service offerings”.

In terms of logistics innovation, Busse and Wallenburg [18] suggest that the innovation literature contains three types of classification: (1) technological vs. administrative innovation; (2) product/service vs. process innovation; and (3) radical vs. incremental innovation. Lin [14,36] distinguishes between technological and administrative innovation, arguing that technological innovation pertains to products, services, and production process technology, while administrative innovation involves organizational structure and administrative processes. Over half of the papers we examined followed the first classification, with a focus on technological innovation, such as Radio-frequency identification (RFID), green practices and cloud computing. None of the reviewed papers explicitly focused on administrative innovations.

We found five papers that applied the second classification, with a focus on service innovation [7,17,27,32,37]. None of the papers in this review explicitly applied the third classification, which may be explained by the fact that logistics innovation tends to adopt existing innovation rather than radically generating anything completely new or disruptive to existing models [18].

4.2. Chinese Institutional Environment for Logistics Innovation

Papers discussing the institutional environment for logistics innovation but without a specific focus on innovation generation, adoption and/or capability were labelled ‘general logistics innovation’. Out of the nine papers in this category, four explicitly discussed the institutional factors that have an influence on logistics innovation in China.

The first paper in this review, by Jiang and Prater [38], mentions that China’s distribution (logistics) sector is shifting from a traditional socialist model to a free market model. However, China’s distribution infrastructure and government regulations are under-developed and regional protectionism fragments distribution channels throughout China. Three main forces/trends, identified as the innovation engines to change and modernize China’s distribution and logistics systems, include the booming economy, China’s entry into the WTO and emergence of e-commerce (ibid).

Daly and Cui [39] identify nine major institutional challenges to e-commerce and logistics and classify them into three types: basic (e.g., availability of information system personnel, logistics knowledge), manageable (e.g., transportation infrastructures, information system data quality) and intractable (e.g., sophisticated logistics systems, global best practice).

Lai et al. [10] discuss the institutional constraints for China's logistics development: industrial protectionism, in which highways, railways and airways are controlled by different government agencies, which lack coordination; regional protectionism, in which local governments set logistics blocks for their own benefit and charge fees to road users; and monopolistic regulations, with state-owned enterprises monopolizing sectors such as rail and freight.

Finally, Ding et al. [40] argue that the shortage of logistics human resources and the lack of logistics expertise are two key contributory factors to the operational inefficiency of the logistics industry in China.

4.3. Innovation Generation

Busse and Wallenburg [18] argue that innovation generation emphasizes the creative process of logistics innovation practices. We found three papers contributing to innovation generation and all of these applied the case study method.

Cui et al. [7] conduct a case study examining the way three regional TPL firms in China, Taiwan and Sweden innovate. These firms generate new service offerings according to consumers' needs, which reflect the regional characteristics.

Cui et al. [32] carry out a longitudinal single case study on an international 3PL firm, analyzing the way innovation emerges and evolves. The study suggests that both intra-organizational and inter-organizational interactions are essential in the innovation generation process, which is complicated and can be both top-down and bottom-up. This study finds that innovation at logistics firms emerges as a combination of an ad hoc response to a customer request and a purpose-driven interactive process.

Finally, Su et al. [41] conduct a longitudinal action research and explore the logistics innovation process of a Taiwanese hospital. The study presents a detailed innovation generation process at the hospital, adopting Flint et al.'s [30] four-step logistics innovation process model: activities to set the stage; activities to gather information about customers; activities involved with negotiation, clarifying and reflecting; and inter-organizational learning. It suggests that the model is not only applicable to customers but also to suppliers. Logistics innovation processes are dynamic and may improve supplier relationships; logistics innovations in the supply chain are as dependent on internal stakeholders as on external relationships; and the logistics innovation process may start out as a dialectic, conflict-ridden process and become a well-ordered, goal-oriented teleological process [30].

4.4. Innovation Adoption

This section discusses the antecedents and outcomes of logistics innovation adoption (also known as innovation diffusion), the topic of 23 out of the 45 papers that we studied.

4.4.1. Antecedents of Innovation Adoption

This topic was covered by 21 papers and the antecedents found are summarized in Table 4 under two types of factors: internal and external. Internal factors include organizational support, quality of human resources, accumulation/compatibility of technology, perceived advantage, financial resources and supply chain relationship. External factors include government support, complexity of technology, regulatory pressure, customer pressure, environmental uncertainty, and competition. Of these factors, organizational support, quality of human resources, accumulation/compatibility of technology, government support and explicitness (complexity) of technology are widely acknowledged as affecting logistics innovation, especially by Lin and his colleagues [36,42,43].

Table 4. Antecedents of logistics innovation adoption.

NO.	Authors	Innovation Focus	Internal Antecedents					External Antecedents						
			Quality of Human Resources	Organizational Support	Accumulation of Technology	Perceived Advantage	Financial Resource	Supply Chain Relationship	Government Support	Complexity of Technology	Regulatory Pressure	Customer Pressures	Environmental Uncertainty	Competition
1	Lin [43]	Technological	✓	✓						✓	✓			
2	Lin [36]	Technological	✓	✓						✓			✓	
3	Lin [14]	Technological	✓	✓	✓					✓	✓			
4	Chang et al. [51]	RFID					✓		✓		✓			✓
5	Fu et al. [53]	RFID				✓						✓		
6	Lin [54]	RFID	✓	✓	✓				✓	✓				
7	Lin [55]	RFID	✓	✓	✓									
8	Lin and Ho [56]	RFID	✓	✓	✓				✓	✓				
9	Tsai and Tang [57]	RFID		✓	✓			✓				✓		
10	Ho et al. [58]	Green innovation	✓	✓	✓									
11	Ho et al. [45]	Green innovation	✓	✓	✓	✓				✓	✓			
12	Lai and Wong [59]	Green innovation		✓	✓							✓		
13	Lin and Ho [42]	Green innovation	✓	✓	✓				✓	✓			✓	
14	Lin and Ho [44]	Green innovation	✓	✓	✓	✓			✓	✓			✓	
15	Abdulrahman et al. [48]	Reverse logistics	✓	✓	✓		✓		✓	✓				
16	Lau and Wang [60]	Reverse logistics							✓	✓				
17	Ye et al. [52]	Reverse logistics								✓		✓		
18	Lai et al. [49]	IT	✓		✓		✓					✓		✓
19	Lin and Lin [46]	IT					✓							
20	Ngai et al. [50]	IT	✓		✓		✓		✓					
21	Subramanian et al. [47]	Cloud computing				✓								
Total Number			13	12	12	6	5	2	11	9	5	5	3	2

Perceived (relative) advantage is “the degree to which an innovation is perceived to be more advantageous than its substitute idea” [44] (p. 70). The relative advantages of green practices have had significant positive influences on the adoption [44] and infusion [45] of green practices of Chinese logistics companies. Lin and Lin [46] suggest that the perceived ease of use and usefulness of RFID directly affects the willingness to accept technology, but indirectly, this willingness affects the adoption of technology. Subramanian et al. [47] argue that the perceived environmental and cost benefits drive the need for cloud computing adoption by Chinese small- and medium-sized logistics service providers (LSPs).

Sufficient financial resource is vital for innovation adoption. Abdulrahman et al. [48] claim that a lack of initial capital and funds for return monitoring systems is one of the barriers in implementing reverse logistics in Chinese manufacturing sectors. Lai et al. [49] and Ngai et al. [50] suggest that insufficient/limited financial support is one of the top perceived barriers to the implementation of IT/IS in Hong Kong’s logistics industry.

In addition, the supply chain relationship/strategy has an effect on innovation adoption. Chang et al. [51] argue that supply chain integration strategy is a critical factor influencing the adoption of RFID for the logistics industry in Taiwan. Lin and Lin [46] find that the supply chain relationship directly affects the RFID adoption behavior.

Of the external factors, regulatory pressures and customer pressures are largely found to enable green and reverse logistics adoption. Ye et al. [52] suggest that while customers have a significant positive influence on top of managers’ attitude towards reverse logistics implementation, the top managers’ attitude is strongly related to product recovery (the manufacturing process) but not product return (the distribution process).

Environmental uncertainty (pressure from competitors, shifting needs of customers, advanced logistics innovations) is found to have a significant influence on technology adoption for LSPs in China [36], and green innovation by LSPs in Taiwan [42].

Finally, Ye et al. [52] propose that competitors have a significant positive influence on top of managers’ attitudes towards reverse logistics implementation. Chang et al. [51] claim that competition in the marketplace is a critical factor influencing the adoption of RFID in the logistics industry in Taiwan.

4.4.2. Outcomes of Innovation Adoption

In contrast to the large number of papers discussing the antecedents of logistics innovation adoption, only seven papers analyzed the outcomes of logistics innovation adoption. Lin [14] and Lin and Ho [56] suggest that the adoption of technological innovations and RFID improves supply chain performance, measured by both financial and non-financial indicators for the logistics industry in China.

Lai and Wong [59] claim that green logistics management positively affects both environmental and operational performance, and regulatory pressure enhances the green logistics management-performance relationships. However, Ye et al. [52] find that product return negatively affects a firm’s economic performance and has no effect on environmental performance.

Tsai and Tang [57] suggest that RFID adoption has positive effects on business practices, which in turn, improve operational performance in terms of reducing tracking costs, expanding current markets, entering into new markets competitively and improving the value chain system.

Shi et al. [37] find that companies are increasingly using 3PL to provide innovative value-added services (e.g., logistics IT, supply chain financing and procurement) and the adoption of the third-party procurement service provided by 3PLs generates mutual benefits for both 3PL providers and users. Finally, Zhang et al. [61] suggest that the adoption of the Internet, the product-service system and cloud computing could enhance the logistics operation performance, decrease costs and reduce environmental pollution.

4.5. Innovation Capability

We found 10 papers that discussed logistics innovation capability, which is a new theme that was not found in Grawe [17] and Busse and Wallenburg [18]. The antecedents and outcomes of logistics capability are shown in Table 5 (however, because Liu et al. [35] do not discuss these factors, the total number of papers shown in the table is nine).

Table 5. Antecedents and outcomes of logistics innovation capability.

NO	Authors	Antecedents		Outcomes											
		Relationship	Resource	Financial Performance					Operational Performance				Overall Firm Competiveness		
				Profit Margin	Market Share	Sales Volume	Return on Investment	Reduced Operation Cost	Customer Satisfaction	Service Quality	Customer Loyalty	Customer Relationship			
1	Daugherty et al. [15]		✓	✓		✓	✓			✓					✓
2	Lu and Yang [62]				✓				✓						
3	Panayides [63]	✓		✓	✓									✓	
4	Panayides and So [64]	✓					✓		✓						
5	Shao and Ji [65]	✓													
6	Yang [66]			✓	✓	✓				✓	✓	✓			
7	Yang et al. [33]		✓	✓	✓	✓	✓		✓	✓	✓				
8	Yeung et al. [67]	✓		✓	✓	✓									✓
9	Subramanian et al. [58]														✓
Total number		4	2	5	5	4	3		3	4	2	2	1		3

4.5.1. Antecedents of Innovation Capability

Four of the papers we examined noted that relationship orientation improves innovation capability. The relationship orientation is defined as “a philosophy of doing business successfully and an organizational culture that puts the buyer-seller relationship at the center of a firm’s strategic and operational thinking” [64] (p. 181). Panayides and So [64] suggest that relationship orientation has a positive influence on key organizational capabilities, such as organizational learning and innovation. Organizational learning mediates between relationship orientation and logistics innovation (ibid). Panayides [63] further identifies that the LSP-client relationship leads to higher levels of innovation capability.

Yeung et al. [67] analyze the relationships among exporters’ strategic orientation towards TPL providers, TPL providers’ capabilities, exporters’ competitive advantage and exporters’ export performance. Their results show that exporters’ strategic orientation towards TPL providers has a significant positive relationship with both TPL providers’ basic capability and augmented innovation capability.

Shao and Ji [66] conduct research on logistics reconfiguration for the Chinese pharmaceutical industry, including both manufacturer and wholesaler. They identify that reliable 3PL provider and supplier supports are among the critical factors for the success of a reconfiguration strategy.

A further two papers discussed the relationship between resource and innovation capability. Yang et al. [33] suggest that a container shipping service firm with a high level of information equipment resources and corporate image have higher innovation capabilities and logistics service capabilities. Daugherty et al. [15] argue that organizational structure is a critical controllable internal factor for organizations to enhance service innovation capability. They propose that organizational structures are resources that exist in three forms: decentralized (centralized), formalized and specialized. They conclude that both decentralization and formalization are positively related to a firm’s logistics service innovation capability, while specialization is not a significant factor because a broader base of knowledge is needed for employees.

4.5.2. Outcomes of Innovation Capability

With regard to outcomes, several papers found that innovation capability has a positive influence on both an organizations’ financial performance (in terms of increased profit margin, growth of market share, increased sales volume, return on assets and reduced operation cost) and operational performance (in terms of customer satisfaction, service quality, customer loyalty and customer relationship). In addition, Daugherty et al. [15], Yeung et al. [67] and Subramanian et al. [68] claim that logistics innovation capability can contribute to overall firm competitiveness.

5. Discussion

5.1. Proposed Conceptual Model of Logistics Innovation

Based on the descriptive analysis and themes identified in the content analysis, we have proposed an integrated framework for logistic innovation in China (see Figure 3). In line with the dominant models in innovation literature, we see innovation as both a process and an outcome [41,69–71], in the sense that innovation generation and adoption form the reciprocal process of innovation, and innovation capability is seen as an outcome of the process. The process view stipulates that the innovation process is reflected in different forms (process or product), types (technological or administrative) and nature (radical or incremental) [71]. The existing innovation literature tends to discuss innovation generation and diffusion/adoption separately and consider adoption a stage of innovation generation, or vice versa [70]. However, the relationship between them is far from clear. Su et al. [41] claim that logistics innovation is a dynamic and conflict-ridden process but they do not explain what ‘dynamic’ means in the logistic innovation context.

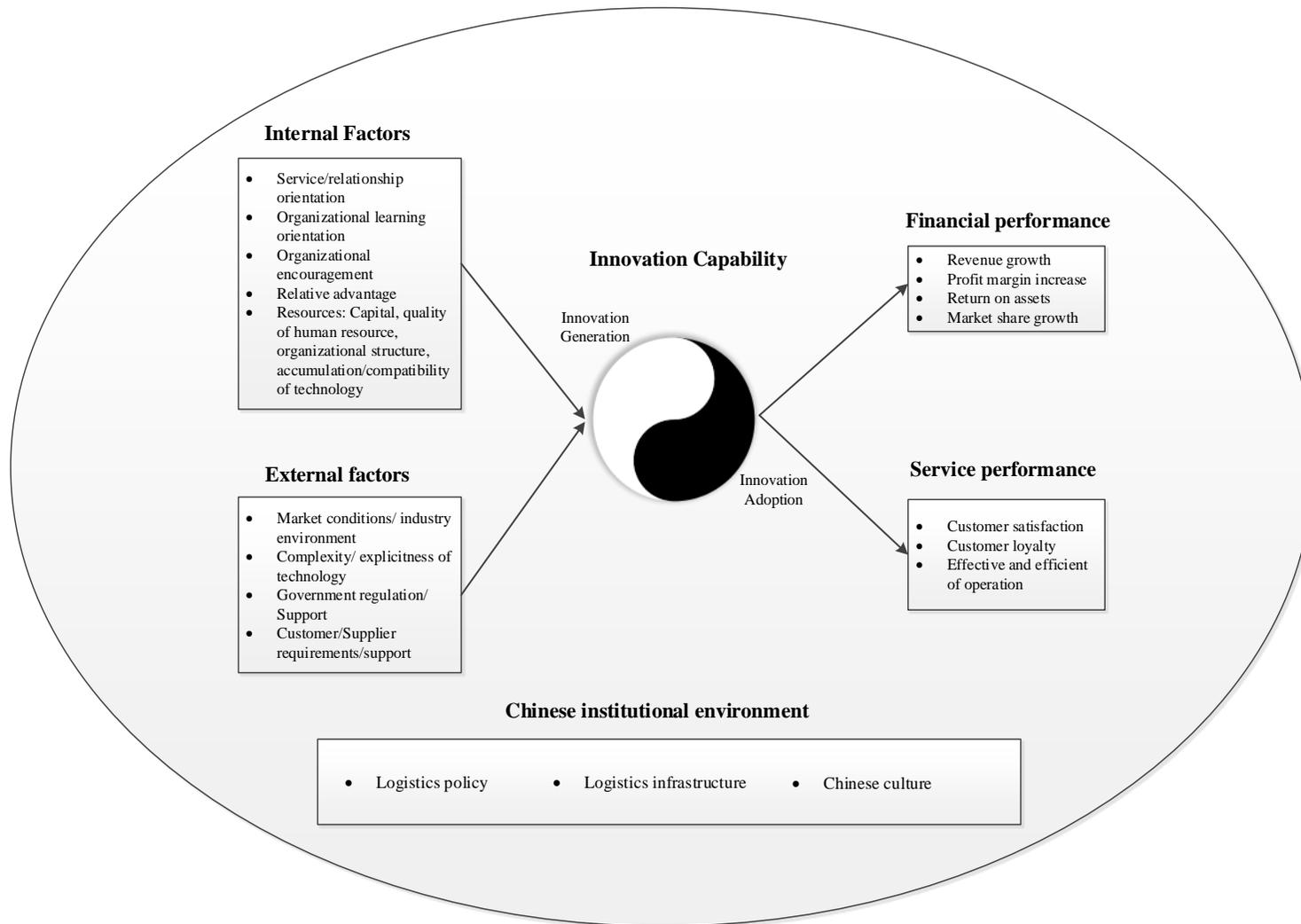


Figure 3. Proposed conceptual model of logistics innovation in China.

Damanpour and Wischnevsky [72] point out that analytically, innovation generation can be separated from innovation adoption. Generation is described as a creative process, including the intellectually demanding “fuzzy front end” development activities and commercialization; in contrast, adoption is seen as a problem-solving process, which involves initiation, decision making and implementation (ibid).

Our conceptual model of logistics innovation was developed from a LSP perspective in China (see Figure 3). This was because approximately half of the papers we examined were focused on LSP (or 3PL), which tends to drive logistics innovation in various industries. The left-hand side Figure 3 shows the multiple factors that influence logistics innovation generation and innovation adoption, according to the literature review we conducted. These factors can generally be classified into two types: internal and external factors, drawn from the antecedents of innovation generation, adoption and capability discussed in Section 4.3 to Section 4.5. The right-hand side of Figure 3 shows that logistics innovation capability has a positive effect on both an organization’s financial performance (e.g., revenue and profits) and its operational performance (e.g., customer satisfaction) [14,15,33,56,66]. In between these, for logistics innovation, is capability perspective; that is, logistics innovations are considered capability, which is reflected in and measured by innovation generation and innovation adoption practices [15,33].

We argue that there are capabilities required for both innovation generation and innovation adoption within a firm and that these are interrelated: in the process of logistics innovation generation, there may also be the existence of innovation adoption activities (e.g., utilizing external technology); in the innovation adoption process, external knowledge may be internalized and used for innovation generation [73].

The relationship between innovation generation and adoption shown in our conceptual model (see Figure 3) fits well with the Chinese philosophy of Daoism: in the innovation context, innovation is born from new ideas (i.e., non-being or nothing) through innovation generation, which further develops in the process of innovation adoption. As noted in the Dao-de-jing (Chapter 42) [21], “one carries two; two begets three and three begets the ten thousand things”). Here, innovation adoption is considered ‘being/existence/yang’, while innovation generation is considered ‘non-being/yin’; that is, a pair of opposites. They complement each other and are brought together under the frame of innovation capability.

In Section 4.2, we showed that the Chinese government’s policy on logistics, the development of logistics infrastructure and the Chinese culture formed the three pillars of the Chinese institutional environment, influencing both the internal and external factors affecting logistics innovation at the macro level in China. These are shown at the bottom of Figure 3.

5.2. Future Research Direction

Our literature review revealed that despite the importance of this topic, there seems to be a lack of research regarding logistics innovation in China in general. First, there is little understanding of the Chinese institutional environment with regard to logistics innovation. Against the backdrop of the recent turbulent global economic environment, together with the increasing costs of labor, land rent and capital expenses, it is clear that logistics innovation in China deserves more attention from researchers. The Chinese government has emphasized the importance of the logistics industry, designating it as one of the 10 restructuring and revitalization industries in 2009 [28]. Therefore, the role that the Chinese government plays in logistics innovation is worth researching as well. This is related to the logistics policy in the conceptual model shown in Figure 3. A comprehensive and up-to-date review of Chinese government policies on logistics innovation is needed to gain deeper insights into the institutional environment.

Another research area neglected by researchers and related to the Chinese institutional environment is the effect of Chinese culture on logistics innovation generation and adoption. Guanxi, the informal network based on kinship and friends, is believed to be a very effective way to mitigate

supply relational risks [74–76] and minimize transportation problems [77]. A possible research direction could be to investigate the ways that LSPs (Western and Chinese) build their social capital (guanxi) with stakeholders of supply networks including governments, nongovernment organizations and traditional supply chain members (buyers and suppliers). The traditional Chinese wisdom provides ‘sparks’ to the relationship between innovation generation and adoption and is worth researching in a logistics innovation context.

Second, in terms of innovation types, we call for research on service innovation [78], as do Chapman et al. [31], who state that the logistics industry should pay more attention to innovations in logistics services. In recent years, in response to the ‘last mile’ challenge, e-commerce players such as Alibaba have revolutionized the logistics in the courier service industry, creating depots at the township level to cater for the demands of consumers in rural areas. New logistics service business models are emerging as a result.

Third, more attention should be given to research on the application and effects of the latest technologies on logistics such as the mobile Internet, cloud computing, big data, the Internet of Things and 3D printing: that is, the ‘Internet Plus’ strategy summarized by Chinese Premier Li, Keqiang in a talk published in ‘Qiushi Theory’, the Chinese Communist Party’s official periodical [13]. The strategy aims to help the manufacturing sector optimize and better serve clients through technologies. The strategy is believed to benefit the logistics industry as well. For example, 3D printing represents the manufacturing trend towards mass customization [79] and it will bring significant changes to the organizational and supply chain structure, of which logistics is a key part. Another example is big data. Capgemini’s [80] analysts declared 2013 to be the start of the ‘big data era’ in supply chains and big data will be an essential and integral element of future 3PL services.

It is surprising, considering the rise of the e-business market, that so little research has been conducted in this area. The rapid development of e-commerce portals started the reshaping of the logistics market by revolutionizing TPL business models (e.g., entering into the e-market) and administrative processes. Success in this rapidly growing market may depend on managing logistics [81].

More research is needed on radical innovation [61,82]. With the rapid development of the mobile Internet, logistics applications (Apps) have reached millions of customers and radical innovation could occur when large investments in the Internet and the logistics industry are made. For example, Didi started in China in 2012, providing fast, reliable, and affordable taxi services for passengers while disrupting the business model of existing taxi service providers and mobilizing the existing transport resources. Considering the fragmented nature of the inland haulage sector, it would not be surprising if a similar business model emerged in this area. In addition, it is worth noting the potential effect of blockchain in transforming the supply chain and logistics industry [83].

Finally, while logistics and supply chain uncertainty and risk management are critical topics in supply chain management, few papers on logistics innovation in China have focused on this topic [84,85].

6. Conclusions

We conducted a content-based literature review on logistics innovation in China and identified five themes: logistics innovation, Chinese institutional environment, innovation generation, innovation adoption and innovation capability. By applying the Chinese philosophy of Daoism, we have developed a conceptual model, as shown in Figure 3. Compared with other reviews [17,18], this study makes several important contributions to knowledge in this area. First, adopting a capability view, we have proposed that innovation capability is an outcome of innovation, measured and reflected in innovation generation and adoption as a reciprocal innovation process. Previous studies have considered logistics innovation as an outcome, not a process [17]; investigated innovation generation from a process perspective, emphasizing early activities [30]; and identified both innovation generation and adoption but not the intrinsic relationship between them [18].

Second, we have further clarified the interaction between innovation generation and adoption by using the Chinese philosophy of Daoism to explain the relationship between them as complementary opposites. This is the first study to apply the philosophy of Daoism in logistics innovation. Daoism elevates logistics innovation to a philosophical level and affords a nomological validity to innovation generation and adoption. In addition, the adoption of the philosophy of Daoism could help to increase allegiance from Chinese managers, whose cultural values are rooted in this traditional philosophy.

Third, in addition to the themes already defined by Grawe [17] and Busse and Wallenburg [18], we have identified three further themes in this area, building a complete framework of logistics innovation in China: the interpretation of logistics innovation, the Chinese institutional environment, and innovation capability.

Finally, we have proposed a number of future research directions on this topic and the practical implications for managers. In addition, the proposed conceptual model could contribute to, and has implications for, logistics innovation in general, not only confined to China.

6.1. Implications for Practice

This review and model development provides logistics managers with a framework of logistics innovation in China that is sensitive to cultural heritage. In the model shown in Figure 3, enabling factors (both internal and external) are identified for LSPs to understand how to enable logistics innovation. The model provides logistics managers with the outcomes of innovation that they could expect if they were to enable logistics innovation (i.e., financial and operational performance). Importantly, we have identified the mechanisms through which logistics innovation can take place (i.e., the dynamic transition between innovation generation and innovation adoption), helping managers understand the way logistics innovation can be generated and adopted. For managers wishing to promote logistics innovation in China, the cultural context must be considered and leveraged to achieve an effective outcome.

6.2. Limitations of the Research

Our research has several limitations. First, we developed our conceptual framework based on the antecedents, outcomes and macro-level factors identified by 45 journal articles; some factors could have been neglected by these researchers. Second, for the convenience of communication we examined only articles in the English language, excluding studies published in the Chinese language, which may provide some insights. Finally, we developed our conceptual framework by adopting the philosophy of Daoism; however, other philosophical principles could be explored in the future.

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Appendix A.

Table A1. Overview of the Reviewed Papers, Organized by Author Name and Year.

NO	Authors	Year	Journal	Category
1	Abdulrahman et al. [48]	2014	International Journal of Production Economics	Innovation adoption
2	Chang et al. [51]	2008	Communications of the Association for Information Systems	Innovation adoption
3	Cui et al. [7]	2009	Transportation Journal	Innovation generation
4	Cui et al. [32]	2010	Journal of Transport and Supply Chain Management	Innovation generation
5	Cui et al. [27]	2012	Transportation Journal	General innovation
6	Daly and Cui [39]	2003	Industrial Marketing Management	General innovation
7	Daugherty et al. [15]	2011	The International Journal of Logistics Management	Innovation capability
8	Ding et al. [40]	2015	International Journal of Production Research	General innovation
9	Fu et al. [53]	2015	The International Journal of Logistics Management	Innovation adoption
10	Ho et al. [58]	2009	International Journal of Organizational Innovation	Innovation adoption
11	Ho et al. [45]	2014	Journal of Economics and Social Studies	Innovation adoption
12	Huang and Yang [86]	2014	Management Research Review	General innovation
13	Jiang and Prater [38]	2002	International Journal of Physical Distribution & Logistics Management	General innovation
14	Lai and Wong [59]	2012	Omega	Innovation adoption
15	Lai et al. [49]	2005	Transportation Journal	Innovation adoption
16	Lai et al. [10]	2008	Journal of Supply Chain Management	General innovation
17	Lau and Wang [60]	2009	Supply Chain Management: An International Journal	Innovation adoption
18	Lin [43]	2006	The Journal of American Academy of Business	Innovation adoption
19	Lin [36]	2007	Journal of Technology Management in China	Innovation adoption
20	Lin [54]	2008a	International Journal of Management	Innovation adoption
21	Lin [55]	2009	Journal of Technology Management & Innovation	Innovation adoption
22	Lin [14]	2008b	International Journal of Technology Management and Sustainable Development	Innovation adoption
23	Lin and Ho [42]	2008	Journal of Technology Management & Innovation	Innovation adoption
24	Lin and Ho [56]	2009	Supply Chain Management: An International Journal	Innovation adoption
25	Lin and Ho [58]	2011	Journal of Business Ethics	Innovation adoption
26	Lin and Lin [46]	2014	International Journal of Electronic Business Management	Innovation adoption
27	Liu [87]	2011	International Journal of Logistics: Research and Applications	General innovation
28	Liu et al. [35]	2010	International Journal of Physical Distribution & Logistics Management	Innovation capability
29	Lu and Yang [62]	2010	The Service Industrial Journal	Innovation capability
30	Ngai et al. [50]	2008	International Journal of Production Economics	Innovation adoption
31	Panayides [63]	2006	European Journal of Innovation Management	Innovation capability
32	Panayides and So [64]	2005	Transportation Research Part E	Innovation capability
33	Shao and Ji [65]	2006	Transportation Journal	Innovation capability
34	Shi et al. [37]	2015	International Journal of Production Economics	Innovation adoption
35	Su et al. [41]	2011	International Journal of Physical Distribution & Logistics Management	Innovation generation
36	Subramanian et al. [47]	2014	Transportation Research Part E	Innovation adoption
37	Subramanian et al. [68]	2016	Industrial Management & Data Systems	Innovation capability
38	Tsai and Tang [57]	2012	Journal of Engineering and Technology Management	Innovation adoption
39	Wang and Xiao [88]	2015	Journal of Transport Geography	General innovation
40	Wu and Cheng [89]	2006	International Journal of Physical Distribution & Logistics Management	General innovation
41	Yang [66]	2012	International Journal of Logistics: Research and Applications	Innovation capability
42	Yang et al. [33]	2009	International Journal of Production Economics	Innovation capability
43	Ye et al. [52]	2013	International Journal of Production Economics	Innovation adoption
44	Yeung et al. [67]	2012	International Journal of Production Economics	Innovation capability
45	Zhang et al. [61]	2016	International Journal of Production Research	Innovation adoption

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