Strategic Transformation into Fourth Party Logistics: A Methodological Approach for Local Logistics Service Providers in Vietnam

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Doctoral Thesis Summary

Tomas Bata University in Zlín

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Faculty of Management and Economics

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Strategická transformace na logistiku čtvrtého typu: metodický přístup místních poskytovatelů logistických služeb ve Vietnamu

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ABSTRACT

Logistics service is a significant component of the service sector. For a few decades, a new model of logistics service providers (LSP) which has appeared and played the role of integrating all operations of the supply chain is mentioned as logistics integrator or fourth party logistics (4PL).

4PL has emerged as an ideal configuration for enterprises around the world to effectively utilize their resources and obtain cost reduction across the supply chain. With the increasing competition among enterprises and customers' requirements in complicated services and global supply chain management, limitations of inbound services from LSPs have become obstacles to their development. As a result, transformation into 4PL is inevitable for LSPs in the global logistics market.

Currently, many researchers demonstrate research results in related elements of logistics services and supply chain management. 4PL's operations and model are analyzed, assessed, and suggested for sustainable development. The orientation and policies in the logistics services are recommended and issued to strongly support and enhance the contribution of the logistics industry to the growth of the national economy. Moreover, investment strategies in the key areas that are established by the government create a high advantage for LSPs in Vietnam to reach outstanding objectives in both the local and international logistics markets. However, the logistics outsourcing trend in the global market that requires more than professional logistics services but high-value-added solutions through long-term contracts between logistics providers and their clients creates LSPs to face challenges in their positioning and competitive advantage in their service provision.

There is a wide range of practices and initiatives that can be used in development enhancement for LSPs. Logistics service practices vary from diverse service provisions to the efficiency of logistics operations concerning all related parties such as suppliers, manufacturers, and customers. Innovative strategies are currently employed as a key element in implementing comprehensive logistics service provision of LSPs to gain and maintain a competitive advantage. Theory of Inventive Problem-solving (TRIZ) serves as the basis for inventive problem-solving methods and tools in a dialectic and systematic way.

This study analyzes the role, importance, characteristics, and benefits of 4PL in the global logistics market. Then, the model for transformation into 4PL for local LSPs in Vietnam is constructed to identify factors impacting the transformation. The results point out six factors influencing the transformation process and three important capabilities of 4PL. Finally, TRIZ innovation methodology is analytically applied to develop strategies for the transformation based on the defined capabilities of 4PL.

ABSTRAKT

Logistické služby jsou významnou součástí sektoru služeb. Již několik desetiletí existuje nový model poskytovatelů logistických služeb (LSP), který se objevil a hrál roli integrace všech operací dodavatelského řetězce, zmiňován jako logistický integrátor nebo logistika čtvrté strany (4PL).

4PL se ukázala jako ideální konfigurace pro podniky po celém světě, aby efektivně využívaly své zdroje a dosáhly snížení nákladů v celém dodavatelském řetězci. S rostoucí konkurencí mezi podniky a požadavky zákazníků na složité služby a globální řízení dodavatelského řetězce se omezení příchozích služeb od LSP stalo překážkou jejich rozvoje. V důsledku toho je transformace na 4PL pro LSP na globálním logistickém trhu nevyhnutelná.

V současné době mnoho výzkumníků demonstruje výsledky výzkumu souvisejících prvků logistických služeb a řízení dodavatelského řetězce. Provoz a model 4PL jsou analyzovány, hodnoceny a navrhovány pro udržitelný rozvoj. Orientace a zásady v oblasti logistických služeb jsou doporučovány a vydávány za účelem výrazné podpory a posílení příspěvku odvětví logistiky k růstu národního hospodářství. Investiční strategie v klíčových oblastech, které stanoví vláda, navíc vytvářejí velkou výhodu pro LSP ve Vietnamu, aby dosáhli vynikajících cílů na místním i mezinárodním trhu logistiky. Trend outsourcingu logistiky na globálním trhu, který vyžaduje více než profesionální logistické služby, řešení s vysokou přidanou hodnotou prostřednictvím dlouhodobých smluv mezi poskytovateli logistiky a jejich klienty, vytváří LSP, aby čelili výzvám v jejich umístění a konkurenční výhodě při poskytování služeb.

Existuje široká škála postupů a iniciativ, které lze použít při zlepšování vývoje pro LSP. Praktiky logistických služeb se liší od různých poskytování služeb až po efektivitu logistických operací týkajících se všech spřízněných stran, jako jsou dodavatelé, výrobci a zákazníci. Inovativní strategie jsou v současnosti využívány jako klíčový prvek při zavádění komplexních logistických služeb poskytovaných LSP za účelem získání a udržení konkurenční výhody. Teorie invenčního řešení problémů (TRIZ) slouží jako základ pro inovační metody a nástroje řešení problémů dialektickým a systematickým způsobem.

Tato studie analyzuje roli, důležitost, vlastnosti a výhody 4PL na globálním logistickém trhu. Poté je vytvořen model pro transformaci na 4PL pro místní LSP ve Vietnamu, aby se identifikovaly faktory ovlivňující transformaci. Výsledky poukazují na šest faktorů ovlivňujících proces transformace a tři důležité schopnosti 4PL. A konečně, inovační metodologie TRIZ je analyticky aplikována k vývoji strategií pro transformaci na základě definovaných schopností 4PL.

CONTENTS

LIST OF ACRONYMS AND ABBREVIATIONS

1PL: First party logistics

2PL: Second party logistics

3PL: Third party logistics

4PL: Fourth party logistics

5PL: Fifth party logistics

CILT: Charter of the Institute of Logistics and Transport

CSCMP: Council of Supply Chain Management Professionals

EDI: Electronic data interchange

ICT: Information and communication technologies

IEA: International Ergonomics Association

IoT: Internet of Things

IT: Information Technology

LPI: Logistics Performance Index

LSP: Logistics service provider

NCPDM: National Council of Physical Distribution Management

SCM: Supply Chain Management

SEM: Structural Equation Model

VIRAC: Vietnam Industry Research and Consultancy

VLI: Vietnam Logistics Research and Development Institute

1. INTRODUCTION

1.1 Research problem and motivations for the study

1.1.1 4PL in the world

4PL is known as a modern model of logistics provision where manufacturing firms outsource their supply chain and logistics activities to external logistics service providers (LSPs). 4PL, also called lead logistics provider, commits to providing comprehensive integrated solutions for supply chain management at a higher level for the customers. Thanks to the ability to handle multiple logistics operations at faster speed and cheaper costs, 4PL has emerged as the integrator handling complex resources to optimize and provide valuable services to its clients. 4PL helps enterprises minimize the concentration on ineffective activities in the supply chain through the implementation of 4PL's innovative solutions. Hence, companies can achieve benefits and promote growth by gaining cost-effectiveness and focusing on core competency. From the 4PL market size global report for the period of 2018-2030 issued by Polaris Market Research, the increasing need for a comprehensive supply chain for productivity enhancement in different market segmentations is expected to develop the global 4PL logistics market. The presence of 4PL creates an essential movement towards mostly eliminating bottlenecks in the complicated supply chain.

1.1.2 4PL in Vietnam

In Vietnam, figures from the General Statistics Office in 2023 show that more than three thousand LSPs are operating in the Vietnamese market, of which 89 percent are domestic enterprises, 10 percent are joint ventures and the remainder are foreign-invested companies. Vietnamese local LSPs have to suffer the pressure of competitors which are foreign logistics corporations. The improvement of competitive ability requires local LSPs to focus on providing high-value-added service solutions such as those of 4PL. 4PL commits to creating comprehensive and integrated logistics solutions to meet the client's growing demands (Li and Lin, 2006; Wang *et al*., 2011). The limitations of LSPs' offered services have strongly promoted the inevitable transformation into 4PL. Therefore, when considering the evolvement of LSPs' services into 4PL, Visser *et al.* (2004) and Hoek (2006) argue that they must have well-defined strategies to begin the transition process.

1.2 Research gap

The number of 4PL service providers is constantly increasing around the world. There are many types of research separately conducted on 4PL's role and model such as the studies of Saglietto *et al*. (2007); Buyukozkan *et al*. (2009); Skender *et al*. (2017); Balanagalakshmi (2018); Christopher S. Tanga and Lucas P.

Veelenturf (2019). Other studies conducted on analyzing and comparing 3PL and 4PL consisting of those of Balanagalakshmi (2018) and Vivaldini *et al*. (2008), establishing suggestions for the transition from 3PL to 4PL with the typical study of Kao *et al*. (2019), and recommending model for conflict resolutions on 4PL development through the research of Kuang *et al*. (2017).

Moreover, there are other research works on related elements to logistics services and supply chain management in 4PL consisting of various services of logistics and customer satisfaction (Huang, 2014), the role of transportation in 4PL (Dircksen and Magnin, 2017; Mehmann and Teuteberg, 2018; Tseng *et al*., 2005), strategies for warehouse operations (Klodawski *et al*., 2017), IT competence (ITC), information and communication technology (ICT), and IoT in 4PL enterprises (Schramm et al., 2019; Mehmann and Teuteberg, 2018; He *et al*., 2013), supply chain resources and monitoring in 4PL (Yao, 2010; Skender *et al*., 2017; Fulconis and Paché, 2018), outsourcing logistics risk management in 4PL (Huang *et al*., 2013).

For the logistics industry in Vietnam, there is one research conducted in strategic development into 3PL for local private logistics companies in Vietnam (Research of Tran Thanh Ha, 2013). Other studies mainly focus on the potential and prospects of the logistics industry in Vietnam including studies by Pham Nguyen My Linh and Nguyen Thi Thu Huong (2020) on The supply chain and logistics of Vietnam in the context of international economic integration; Banomyong *et al*. (2015) on Assessing the National logistics system of Vietnam; Hoang Phuong Nguyen (2020) on Sustainable development of logistics in Vietnam in the period 2020-2025; Hoang Phuong Nguyen (2020) on Human resource management of logistics in Vietnam: status and policy solutions; Hai Nam Vu (2019) on Strategic development in logistics in Vietnam; Le *et al*. (2020) on Using the optimization algorithm to evaluate and predict the business performance of logistics companies – A case study in Vietnam. However, there isn't any research on the transformation from LSP to 4PL, especially in the context of local logistics service providers in Vietnam. Therefore, this study is performed as the first one on this topic with expectations of contributing to the development of the logistics industry in Vietnam and in the academic field as well.

1.3 Research objectives

Based on reviewing literature and observations of Vietnam and the global logistics industry, the author specifies the main goal of the dissertation as to investigate factors affecting the transformation into 4PL of local LSPs in Vietnam. Besides, the supplementary objectives are also established to assess the importance of 4PL in the logistics service industry and global supply chain, and then, to build strategies for the successful transformation. As a result, the thesis is conducted with 3 core and 9 specific objectives as stated in the following parts.

In the development and transformation process of LSPs, LSPs operate under the influence of many factors in both macroeconomic and microeconomic sectors. Therefore, the assessment of how impact of constructs in each economic sector is essential to the probability of the transformation model. Hence, research objective 1 is determined to affirm whether the research model is significant.

**RO1: To investigate factors affecting the transformation into 4PL of local LSPs in Vietnam.*

4PL acts as an integrator for offering a wide range of solutions to help firms achieve the highest productivity. The recent outsourcing trend concentrates on integrated solutions under long-term contracts of 4PL instead of using separate logistics services provided by 2PL and 3PL. The research systemizes theories and empirical studies in 4PL to affirm the position of 4PL in the global logistics market and supply chain.

**RO2: To systemize the theories in the role, importance, and characteristics of 4PL in the logistics service industry and global supply chain.*

To survive under the pressure of competition in the global logistics market where various giant logistics corporations are expanding their operations across nations with worldwide networks, Vietnam's local LSPs must be adaptable and willing to execute changes. With the composition of Vietnam's logistics industry of mostly 2PLs and a small part of 3PLs, transformation into 4PL for maintaining survival and achieving a competitive advantage is an inevitable development in the new era of the global logistics industry. RO3 is established for generating strategic solutions through the application of an innovative approach.

**RO3: To develop strategies for successful transformation into 4PL of local LSPs in Vietnam.*

In summary, this study leads the findings to provide deep insights into the investigation of factors influencing the transformation into 4PL, the systemization of theories and comprehensive concepts of 4PL in the logistics service industry and global supply chain, and innovative strategies for the significant transformation. These objectives could be specified by giving answers to established research questions in the following part.

1.4 Research questions

From the research problem, motivations, and research objectives, research questions (RQ) are set up to strengthen the research basis and clarify the main content of the study by comprehensive answers for the following research questions:

**RQ1: Why should local logistics service providers in Vietnam transform into 4PL?*

This research question analyzes the situation of the logistics market in the world and in Vietnam where there are different levels of logistics enterprises operating under fierce competition. The characteristics of 2PL, 3PL, and 4PL are specified to highlight the differences between these types of LSP.

**RQ2: Which factors impact the transformation into 4PL of local logistics service providers in Vietnam?*

LSPs operate their business under the influence of many macroeconomic and microeconomic factors. The existence of these diversified factors can become facilitators or obstacles to the development of logistics enterprises. This research question aims to investigate the influence that LSPs suffer when they execute the transformation process to a higher level of logistics services. Critical factors that are motivators or constraints to the transformation should be determined and examined for their interactions with the changes to evaluate the probability of the transition from LSP into 4PL.

4PL is an advanced model of LSP due to its valuable benefits delivered to the client. Being considered an integrator of 3PL's resources, technology, and skills, 4PL creates high benefits such as a powerful data system, professional supply chain, operational efficiencies, and cost reduction. It is also the explanation for the necessity of the transformation into 4PL of LSPs. RQ3 is designed to provide direction to LSPs to catch up with their changing strategy.

**RQ3: How do local logistics service providers in Vietnam successfully transform into 4PL?*

It is obvious to affirm that local LSPs need to transform themselves to retain their existence and enhance their development through appropriate and practical strategies. This research applies TRIZ innovative approach to develop strategies for the transformation into 4PL for local LSPs in Vietnam.

1.5 Research design

In this study, the author determines three main objectives concerning the systemization of distinguishing concepts of 4PL, the investigation of factors impacting the transformation into 4PL, and the innovative strategies for the advanced transformation of local LSPs in Vietnam corresponding to three main research questions.

Apart from the acknowledgment and the abstract, the dissertation is carried out in ten chapters. A sketch map with the main parts of the research design is illustrated in Figure 1.2. The given chapters of the study provide all relevant knowledge, theory, data, processes, analyses, evaluation, and solutions for the research problem. In further affirmation of the research design, the process presents all essential stages and expertise content of the research to finally create the completed study for devoting remarkable contributions in the logistics field.

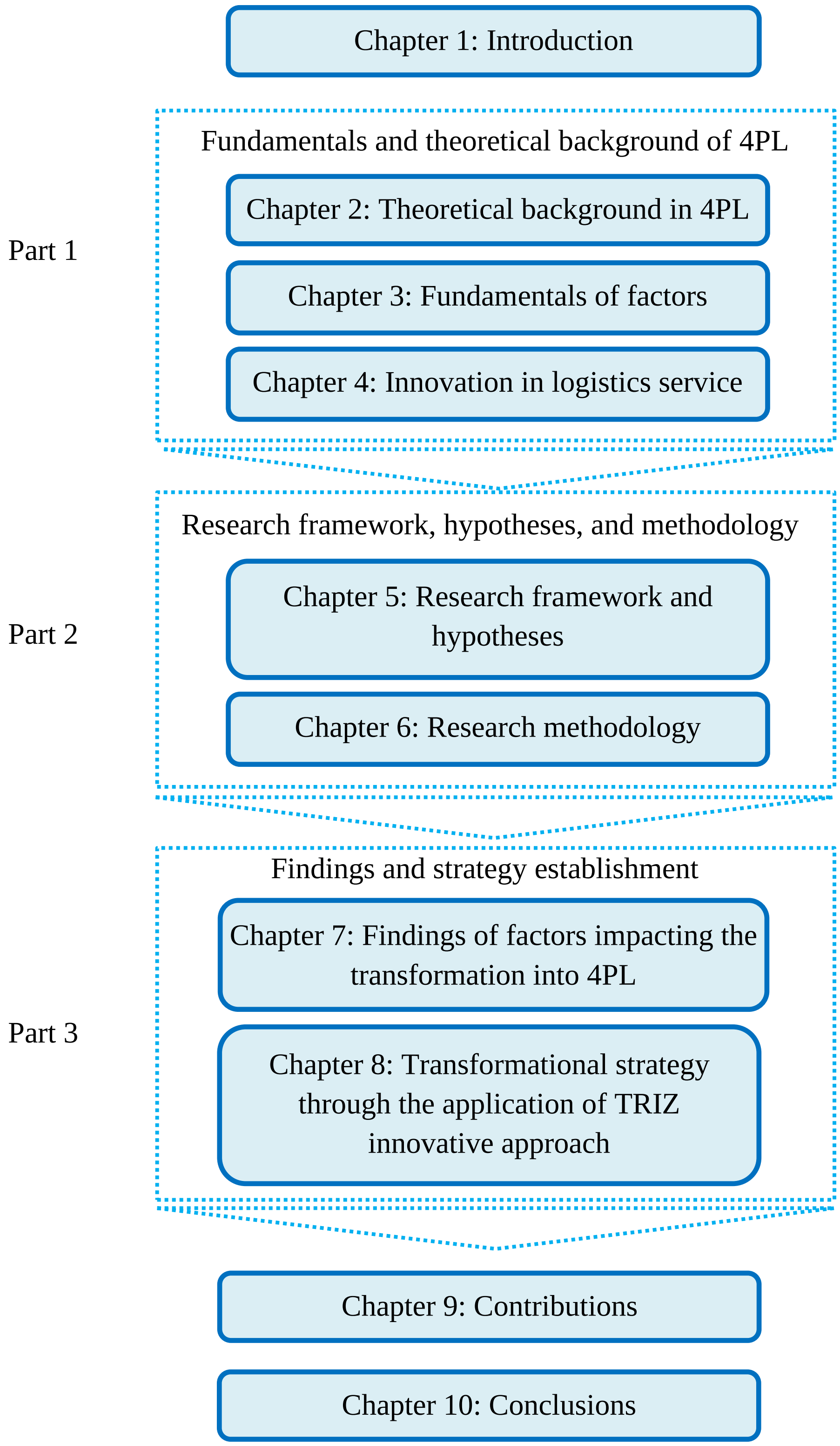

Figure 1.1: Research design

Source: The authors' works

2. THEORETICAL BACKGROUND

2.1 Theory of transformation into 4PL

In the context of changes in the global market, the logistics industry is dramatically influenced by many factors. However, it leads to opportunities for LSPs to promote value creation in logistics operations and to stipulate new management forms of the supply chain (Schaltegger *et al.*, 2016). The supply chain is likely to make a transition remarkably due to the impacts of those changes. Then, integrated solutions mentioning the core elements of business strategies are essential for the management of transformation in the entire supply chain to ensure sustainability (Schaltegger *et al.*, 2016). Hence, LSPs' understanding of their transformation potential will motivate them to develop their business models in an innovative, integrated, and sustainable way. Accordingly, when regarding the development of LSPs to 4PL, Visser *et al*. (2004) analyzed the transformation process into 4PL and suggested that LSPs should have good preparation for the transition. Hoek (2006) highlighted several advantages in the transition from LSP to 4PL in his study.

2.2 Key attributes of 4PL

2.2.1 Value chain creation

4PL has become an ideal integrator that provides enterprises with multifunctional outsourcing. Moreover, they are turning to 4PL to construct relationships with partners during their supply chain to focus on cost-cutting and dealing with unexpected matters in supply and demand so that they ultimately have the best results in their operations (Frost and Sullivan, 2005). 4PL's capacity in value creation depends on its ability to choose and combine resources that create extreme value for its clients under specific strategy customization. The benefits of added value that client firms achieve when outsourcing logistics operations to 4PL are mentioned in Figure 2.2.

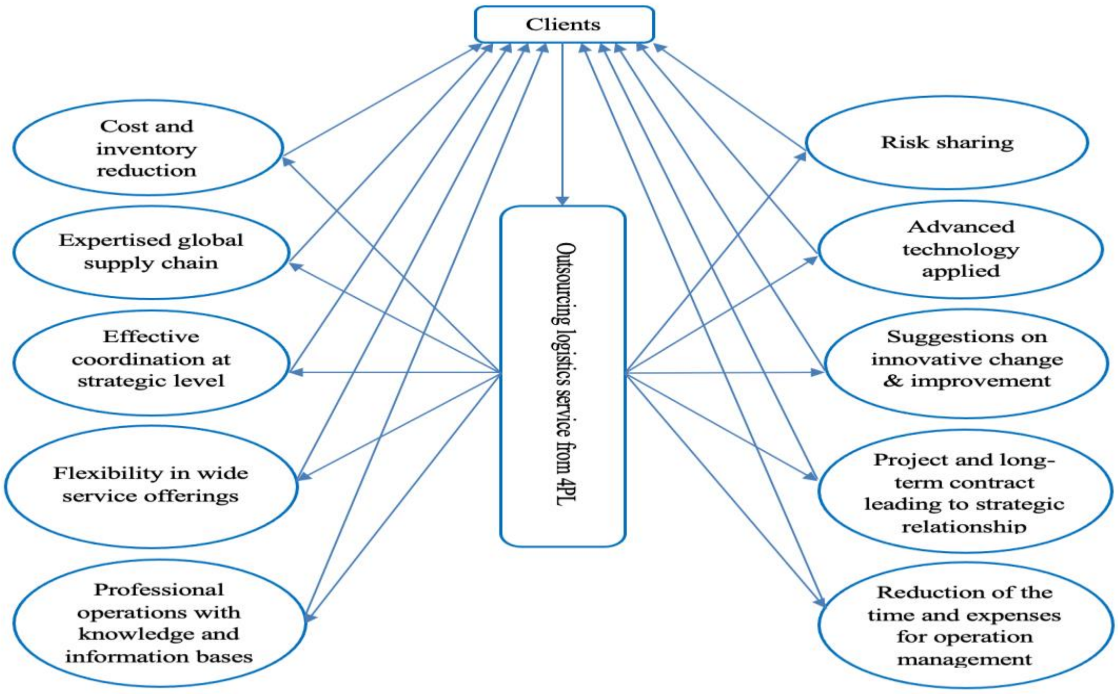

Figure 2.1: Value achieved from outsourcing logistics service from 4PL

Source: Frost and Sullivan, 2005

With the main goal of focusing on the whole supply chain system, 4PL can effectively integrate a variety of fragmented external resources and create value for the clients through customized solutions in six groups of activities including cost and expense savings; reduction of risk inventory; expertise in global supply chain and operations; flexible service offerings; strategic coordination in the long-term contract; innovation and improvement suggestions with advanced technology application.

2.2.2 Integration of multiple 3PL providers' activities

Langley *et al*. (2005) differentiated logistics models into two-tiered relationship structures with details in relationship attributes and service attributes. For relationship structure, 3PL operates at the tactical level while 4PL's activities are at the strategic level. In terms of relationship attributes, 4PL works with characteristics such as partnership joint venture, value-based, risk sharing, few partners, long-term, common core value, alignment, and trust. Coyle *et al*. (2003) noted that the trend toward the application of 4PL appears where 3PLs' activities are managed to ensure operations in the supply chain for enterprise customers. Under a strategic role, 4PL works as the integrator to provide benefits to customers by connecting their needs and available resources from the network of 3PLs, IT providers, and consultants. In addition, Frost and Sullivan (2004) affirmed that 4PL, being considered a breakthrough supply chain solution, integrated effectively competencies of 3PLs, superior consulting companies, and IT providers.

2.2.3 Management of global supply chain

According to Cooper *et al*. (1997), supply chain management is understood as a system of enhancing the integration of activities to create a value-added chain for customers. Wildemann (2001) pointed out the aims of supply chain management as optimization of process cycles, improving the service value, and increasing flexibility of logistics operations through utilizing resources in efficient and cost-effective ways. Rajaguru and Matanda (2013), Kasperek (2013), Win (2008), Yao (2010), and Vinay *et al*. (2009) proved that 4PLs could be able to reach these objectives through strategic planning within the supply chain. Based on the definition of the Consulting group Accenture, the core superiority of 4PL is to make the integration of resources in the supply chain. Customers could be provided customized integration solutions with fast, high-quality, and cost-effective logistics services.

3. INNOVATION IN LOGISTICS SERVICE

3.1 TRIZ innovative approach

3.1.1 Fundamentals of TRIZ

TRIZ, the Russian acronym for "Theory of Inventive Problem Solving", was developed by Henrich Altshuller in 1946 and has been applied in different industries. Based on the principles of TRIZ inventive approach, Simon (1977) pointed out four steps in problem-solving: defining the problem, constructing solutions, selecting solutions, and implementing solutions. However, Mann (2009) made some changes in this problem-solving process in which four steps are problem identification, tool selection, solution generation, and solution evaluation. Meanwhile, four steps in the analytical application of TRIZ are suggested by Waransky (2002) including identifying the problem, determining the parameters for improving and worsening, studying innovative principles, and formulating strategies. According to Mann (2007), TRIZ's systematic innovative process leads a specific problem to a specific solution through two generic steps of problem and solution in the process derived from 39 engineering variables, 40 inventive principles, 76 standard solutions, and TRIZ contradiction matrix.

3.1.2 TRIZ contradiction matrix

The model of the TRIZ contradiction matrix is constructed to generate recommendations for solving existing problems that appear in both engineering and service areas. The matrix is constructed with 39 engineering variables arranged in vertical and horizontal directions forming a 39 x 39 matrix. In this study, this model is applied as an effective tool for developing strategies for LSPs to transform into 4PL. Improving and worsening features are investigated based on 4PL's characteristics that LSPs need to achieve. Details of the implementation process and strategy development are presented in Chapter 3.2 and Chapter 7.

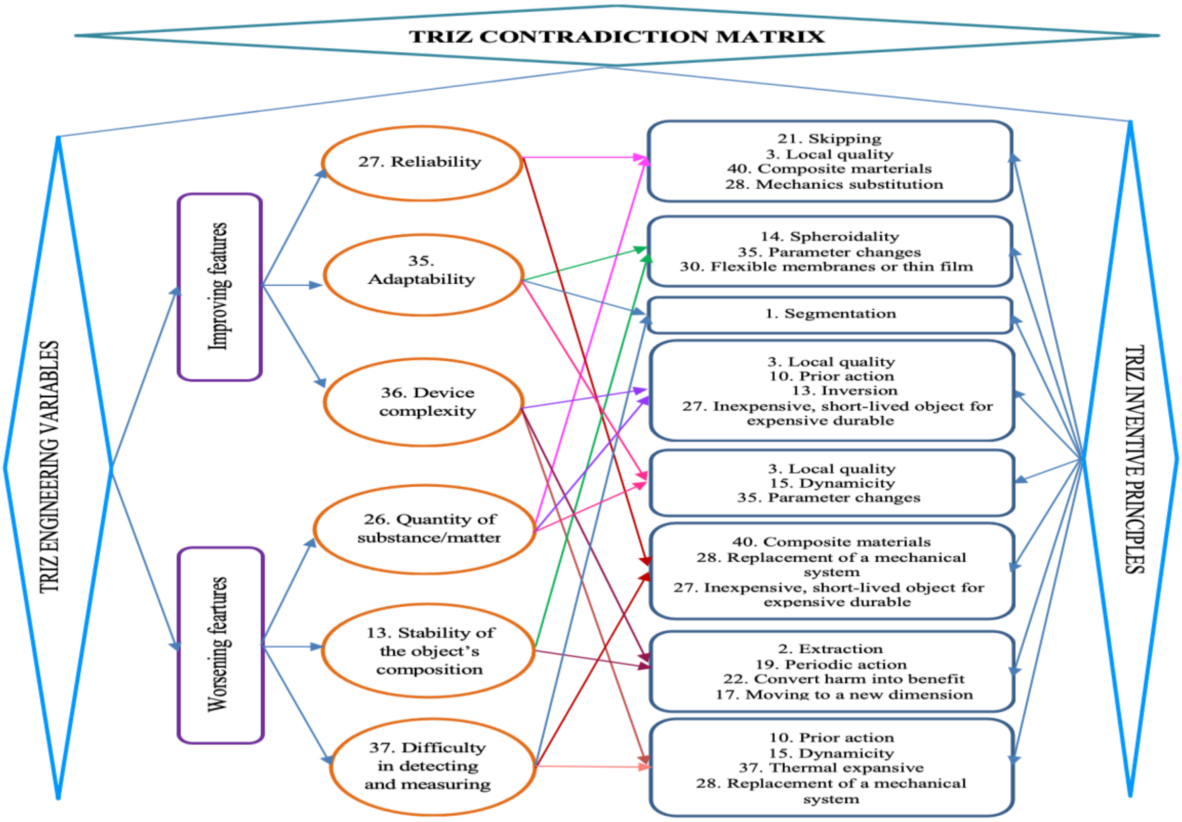

Figure 3.1: Model of TRIZ contradiction matrix

Source: Altshuller, 2002

3.2 TRIZ implementation in developing strategy for the transformation into 4PL

Being adapting to solve different kinds of problems, TRIZ methodology mentions contradictions as the core concept for creating inventive solutions. There are various methods for solving contradictions by applying the TRIZ matrix. Waransky's algorithm which is mentioned as one of the effective ways for constructing development strategies for enterprises consists of 4 stages in the process as follows:

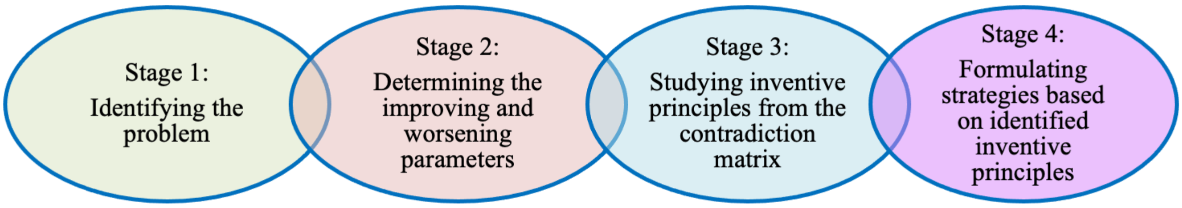

Figure 3.2: Process of TRIZ implementation

Source: Waransky, 2002

The core goals of the process are to affirm the effective application of TRIZ in the service field and to develop strategies for local LSPs in Vietnam to transform into

4PL through the implementation of TRIZ inventive methodology on the identified capabilities of 4PL under the research of Porter (1996), Walters and Rainbird (2007), Frost and Sullivan (2014), Fulconis et al. (2006), Rajaguru and Matanda (2013), and Diem *et al.* (2023). Three main capabilities of 4PL including value chain creation, integration of multiple 3PL providers' activities, and management of global supply chain are considered as problems in which local LSPs must identify contradictions and determine relevant innovative solutions.

4. RESEARCH FRAMEWORK AND HYPOTHESES

4.1 Formulation of research model

The model consists of two groups of factors in microeconomic and macroeconomic sectors. In the first group, there are five microeconomic constructs including transportation capability, warehouse operations, IT application, human resources, and logistics services to be investigated in their impact on the transformation into 4PL. The second group includes four factors in the macroeconomic sector consisting of transportation infrastructure, logistics outsourcing trend, policies in logistics industry, and competition in logistics market which will be assessed specifically for affirming their role in the transformation process. The research model is illustrated in Figure 4.1.

In the model, TRIZ inventive approach is applied to establish the development strategies for local LSPs in Vietnam. After evaluating factors impacting the transformation into 4PL, three attributes of 4PL are evaluated by TRIZ methodology with 39 engineering variables, 40 inventive principles, 76 standard solutions, and the contradiction matrix.

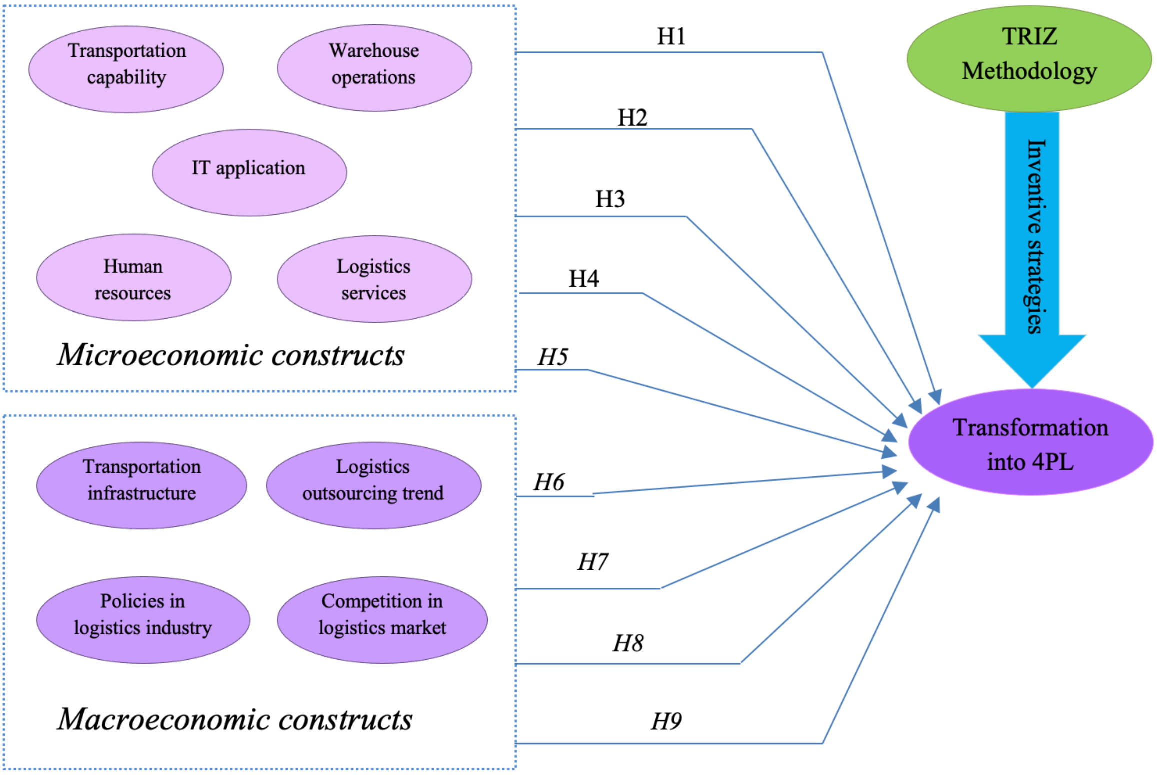

Figure 4.1: Model of variables influencing the transformation into 4PL

Source: The author's suggested research model

4.2 Scales of measurement

From the conceptual model, scales of measurement for 10 constructs, so-called variables, which include independent and dependent factors are established with a total of 31 indicators developed from previous concepts and studies in logistics service provider and transformation into 4PL. All indicators are measured on five-point Likert scale (1 = Very high, 2 = High, 3 = Medium, 4 = Low, 5 = Very low). Specifically, constructs and indicators are as follows:

Table 4.1: Research constructs and indicators

Descriptions	Sources
Transportation capability (TRA)	
TRA1: Owned means of transportation	Morash and Clinton (1997); Chang (1988); Mason *et al*. (2007); Park (2011); Vidalakis et al. (2011); Smith and Nash (2014); Mandic *et al*. (2014); Chakhtoura and Pojani (2016); Rodseth (2017); Cui and Li (2017a, 2017b, 2017c).
TRA2: Speed of transportation nationally and internationally	
TRA3: Connection of transportation chain and logistics services	
Warehouse operations (WOP)	
WOP1: Scale of owned warehouse	Berry (1968); Roberts *et al.* (1972); Chew *et al.* (1999); Rouwenhors *et al.* (2000); Bozer *et al.*
WOP2: Technology application	

WOP3: Rate of errors WOP4: Cross-docking utilization	(2005); Le-Duc *et al.* (2005); Frazelle (2008); Yu *et al.* (2009); Gu *et al.* (2010); Jacyna-Gołda (2014); Żak (2014); Jacyna et. al. (2016); Michał *et al.* (2017).
Advanced IT application (ITA)	
ITA1: Highly qualified IT human resources ITA2: Advanced IT infrastructure ITA3: Strong partnering relationship between IT and logistics service management	Stank *et al.* (1999); Devaraj and Kohli (2000); Lim and Palvia (2001); Weill *et al.* (2002); Sauvage (2003); Sabherwal and Jeyaraj (2015); Bardhan *et al.* (2007); Jayaram and Tan (2010); Pinna *et al.* (2010); Sinkovics *et al.* (2011); Evangelista *et al.* (2012); Ghobakhloo and Hong (2014); Karagöz and Akgün (2015); Chaysin *et al.* (2016); Wong *et al.* (2016).
Human resources (HRM)	
HRM1: Specialized competence HRM2: Planning and controlling capability HRM3: Learning and integrating competence	Gatewood and Field (1994); McDaniel *et al.* (1988); Elsdon (1999); Ginter and La Londe (2001); Neumann and Dul (2010); Kam *et al.* (2010); Okeudo (2012); Anastasiou (2012); Alexander *et al.* (2013); Hall *et al.* (2013); Battini *et al.* (2015); The International Ergonomics Association (IEA, 2019).
Logistics services (LOS)	
LOS1: Provision of diversification and strategy customization of logistics services LOS2: Provision of value-added services to customers LOS3: Logistics service costs	Mangan *et al.* (2008); Bert *et al.*, (2010); Gattorna (2010); The Charter of the Institute of Logistics and Transport (CILT, 2012); Badenhorst-Weiss & Waugh (2014).
Transportation infrastructure (INF)	
INF1: Airport infrastructure INF2: Harbour infrastructure INF3: Land infrastructure	Fair *et al.* (1981); Chang (1988), Grzelakowski (2014), Bolumole *et al*. (2015).
The growth of logistics outsourcing trend (OUT)	
OUT1: Trend of logistics outsourcing OUT2: Size of an organization adopting logistics outsourcing	Sheffi (1990); Sink and Langley (1997); Gattorna (1998); Skjoett-Larsen (2000); Hoffman (2000); Tyan *et al.* (2003); Folinas *et al.* (2004); Frankfurt (2005); Mukhopadhyay (2006); Jiang *et al.* (2006); Bourlakis and Bourlakis (2005); Lau and Zhang (2006); Bardhan *et al.* (2006); Lau and Zhang (2006); Gavrielatos (2007); Aimi (2007); Krakovics *et al.* (2008); Marasco (2008); Langley & Capgemini (2008); Deepen *et al.* (2008); K.

OUT3: Levels of logistics outsourcing	Gotzamani *et al.* (2010); Soinio *et al.* (2012); Solakivi *et al.* (2013).
Competition in the logistics industry (COM)	
COM1: Number of rivals who are LSPs in the logistics market	Amstrong and Associates (2017), Yao and Zhang (2012), Ha *et al*. (2003), Ghiani et al. (2004), Chen (2008), SteadieSeifi (2011), Park and Min (2017).
COM2: Market share of LSPs in the logistics market	
COM3: Types of rivals' logistics service provision: 2PL, 3PL, 4PL	
Policies in the logistics industry (POL)	
POL1: Policies in the logistics industry	Pilar *et al.* (2004); Hai *et al.* (2005); Masahiro (2010); Magnus & Ruth (2010); Hens *et al.* (2011); Jin (2012); Liu *et al.* (2013); Shuihai *et al.* (2014).
POL2: Supported policies for LSPs	
POL3: Directions and strategies of government for the development of the logistics industry	
Transformation into 4PL (4PL)	
4PL1: Value chain creation	Porter (1996); Frost and Sullivan (2005); Hoek (2006); Walters and Rainbird (2007); Bowersox *et al*. (2007); Schaltegger *et al.* (2016).
4PL2: Integration of multiple 3PL providers' activities	Coyle *et al*. (2003); Frost and Sullivan (2004); Langley *et al*. (2005); Boschian and Paganelli (2016); Govindan *et al.* (2016); Gruchmann (2019).
4PL3: Management competence in global supply chain	Cooper *et al*. (1997); Bechtel and Jayaram (1997); Christopher (1997); Lambert *et al*. (1998); Frohlich and Westbrook (2001); Wildemann (2001); The Council of Supply Chain Management Professionals (CSCMP, 2004); Rafele, 2004); Visser *et al*. (2004); Trent and Monczka (2005); Zailani and Rajagopal (2005); Fulconis *et al*. (2006); Laurence *et al.* (2007); Win (2008); Vinay *et al*. (2009); Yao (2010); Jianming Yao (2010); Cao and Zhang (2011); Kastalli and Van Looy (2013); Rajaguru and Matanda (2013); Kasperek (2013); Kim and Min (2015); Karimi and Walter (2016); Schaltegger *et al.* (2016); Verwaal (2017).

Source: The author's study

4.3 Formulation of Research hypotheses

Based on the main research objective of the dissertation, the author developed research hypotheses to find authentic answers to the mentioned research questions. Nine hypotheses are designed based on the identified factors impacting the transformation into 4PL of local LSPs in Vietnam including:

In the logistics industry, transportation capability is considered one of the key elements of competitive ability between LSPs because transportation is an important activity out of core operations provided to their customers.

**H1: High transportation capability fosters the strategic transformation into 4PL of local LSPs in Vietnam.*

In logistics and supply chain, warehousing and inventory storage are core components that create high value in delivering logistics operations to the client. Warehousing is essential in the supply chain because it is an intermediate point in the distribution of products from manufacturers to consumers.

**H2: Effective warehouse operations have positive influence on the strategic transformation into 4PL of local LSPs in Vietnam.*

With the development of the global economy, the application of IT in creating the connection of logistics systems over the countries is significant in enhancing competitive advantage for LSPs. According to the results of a survey conducted by Vietnam Report, all of the LSPs have increased their investment in digital transformation in the last years.

**H3: Absolute level of advanced IT application has positive impact on the strategic transformation into 4PL of local LSPs in Vietnam.*

Human resources is a vital part of any logistics enterprise because the shortage of qualified workforce can cause obstacles to logistics operations such as inventory management, warehousing, packaging, labeling, transportation, and distribution. Effective human resource strategy creates the guarantee to LSPs for ensuring the competitive advantage.

4: High-qualified human resources cause a positive influence on the strategic transformation into 4PL of local LSPs in Vietnam.

Logistics is one of the service industries that plays an increasingly important role in the world and national economy. Logistics determines the circulation of the entire supply chain, production, and distribution of goods in the market. Along with the socio-economic development, the quality of logistics service becomes a competitive advantage to ensure the success of enterprises.

**H5: High-quality logistics services create a positive impact on the strategic transformation into 4PL of local LSPs in Vietnam.*

One of the important objectives of the logistics industry is cutting costs. There is a variety of solutions for gaining cost-effectiveness such as applying digital technology, improving the qualifications of operational staff, enhancing facilities and premises, etc. However, one of the basic ways for logistics cost reduction is to decrease transportation costs based on a comprehensive strategy and sound transportation infrastructure.

**H6: Good transportation infrastructure fosters the strategic transformation into 4PL of local LSPs in Vietnam.*

Logistics outsourcing brings a lot of benefits to enterprises. Firstly, the client companies reduce investment capital and costs when using logistics service outsourcing from LSPs. Secondly, LSPs' expertise importantly contributes to the enhancement of service quality and meets customer's requirements. The development of this trend affirms that the growth of the logistics outsourcing trend may have a certain impact on the transformation into 4PL of LSPs in Vietnam.

**H7: The growth of the logistics outsourcing trend creates positive impact on the strategic transformation into 4PL of local LSPs in Vietnam.*

Digitalization has been creating many challenges for LSPs, requiring them to adapt quickly and integrate into the 4.0 economy to be competitive and survive. In the flow of the 4.0 technology era, it is imperative that the logistics industry quickly and comprehensively transform to catch up with this trend.

**H8: The increase of competition in the logistics market causes positive influence on the strategic transformation into 4PL of local LSPs in Vietnam.*

Currently, the logistics industry in Vietnam and the world is assessed as one of the potential fields and supported by many directions, resolutions, policies, plans, and strategies for completed development over a period.

**H9: Completed government policies in the logistics industry create positive stimulation to the strategic transformation into 4PL of local LSPs in Vietnam.*

5. RESEARCH METHODOLOGY

5.1 Research approach

The general research approach of this study is based on Accenture's concept of 4PL, transformation into the new model of logistics provider of Visser *et al.* (2004) and Hoek (2006), related parties in 4PL of Gattorna (1998), and 4PL's characteristics of Win (2008). Following this perspective, this study concentrates on the analyses of factors impacting the development of local logistics enterprises in Vietnam. Then, TRIZ innovative approach is applied to build strategies for the transformation into 4PL of Vietnamese LSPs which are mostly small and medium-sized firms.

This study contributes to the development of theoretical and conceptual models for identifying determinants of the growth of logistics firms at the industry level. The main object of this research is limited to the domain of local enterprises in the logistics industry in Vietnam. To implement the main research objective, this study was first conducted with a literature review on various definitions of 4PL and constructs in the model. Then, the PLS-SEM model is applied to identify constructs affecting strategic transformation into 4PL of local LSPs. From the results, development strategies for LSPs to transform into 4PL through TRIZ innovation methodology are proposed. The authors apply TRIZ's innovative problem-solving process with four analyzed steps suggested by Savransky (2002) to generate seven strategies for enhancing the effectiveness of the defined capabilities of 4PL. The findings and recommendations drawn from the study have considerable implications for both academic and practice fields alike.

5.2 Research data and sample size

The author uses statistical data from a data collection survey from 414 LSPs in the logistics industry in Vietnam. Respondents to the survey are categorized by operations and geographical locations. To ensure the reliability and validity of the measurement index, the reliability analysis Cronbach's Alpha and Average Variance Extracted (AVE) through SmartPLS 4 is applied to eliminate variables uninterpretable to the research concept.

In this dissertation, the Structural Equation Model (SEM) is used to analyze the relationships between the dependent variable (transformation into 4PL) and independent variables (transportation capability, warehouse operations, IT application, human resources, logistics services, transportation infrastructure, logistics outsourcing trend, competition in logistics market, and policies in logistics industry) in the model. This method requires a large number of samples due to its dependence on sample distribution theory (Vinzi *et al.*, 2010; Garson, 2016). Besides, Hair *et al*. (2017) affirmed that there are three types of sample size used in SEM including small size at ≤ 100, medium size at 100 – 200, and large size at ≥ 200. The sample size of this study is 414, therefore, it meets the requirement in sample size for the research.

5.3 Survey method

Survey methodology has proved a valuable research tool to approach various components in the logistics industry from different areas in Vietnam. Nine groups of surveyed logistics enterprises from three parts of the country provide adequate information and a complete image of the logistics industry in Vietnam. For data collection, both online and offline surveys were conducted with the target population of LSPs in different categories to investigate the factors influencing the transformation into 4PL from 2PL and 3PL. To gain a more profound understanding of the capability to transform into 4PL, nationwide local LSPs which are of diversified categories of logistics enterprises are selected for the study. Most local logistics firms are small and medium-size with limited competitive advantage in the logistics industry. Therefore, they need to develop their business to a higher level for survival and growth in the fierce competition in the global logistics market.

5.4 Conceptual model evaluation and hypotheses testing

Based on the systematic procedure of Hair *et al*. (2017), the objectives and hypotheses of the study, Structural models, and Measurement models are developed to state the relationships between observed variables and latent variables and between the constructs and their relevant indicators as shown in Table 5.1. From the literature review, the factors including 4PL, TRA, ITA, HRM, LOS, COM, OUT, WOP, INF, and POL are assumingly measured by 31 reflective indicators. The specific survey questions are designed for separate indicators as stated in Table 5.1. According to Hair *et al.* (2019), hypothetical model evaluation and hypothesis testing are implemented as follows:

Evaluation of Measurement models

The measurement models are critically evaluated through the metrics of Discriminant validity, Convergent validity, and Internal consistency with their relevant indicators and thresholds as shown in Table 5.1.

Table 5.1: Evaluation of Measurement models

Metrics	**Indicators**	**Thresholds**
Convergent validity	Outer loadings	≥ 0.70
	Average variance extracted (AVE)	≥ 0.50
Internal consistency	Cronbach's alpha	0.60 - 0.95
	Composite reliability	0.60 - 0.95
	Rho-A	0.70 – 0.90
Discriminant validity	Heterotrait-Monotrait Ratio of Correlations - HTMT	≤ 0.9

Source: Hair *et al*. (2017, 2019)

From the theory of Hair *et al*. (2017, 2019), over 50% of indicators are acceptable in explaining the construct when outer loadings are from the value of 0.70. The internal consistency of indicators within the construct is measured by Cronbach's alpha and Composite reliability. When Cronbach's alpha is in the amplitude from 0.60 to 0.95, and the Composite reliability has simultaneously the minimum of 0.60 and maximum of 0.95, the consistency of a measurement model is defined. Rho-A which is used to evaluate the reliability of the internal consistency of the construct is assessed to be fit to the measurement model when it is at the thresholds from 0.70 to 0.90.

Discriminant validity shows the distinctiveness of a construct when compared to other constructs in the model. Fornell and Larcker (1981) proposed the use of the AVE square root as an approach to evaluate discriminant validity and recommended that discrimination is assured when the square root of the AVE for each latent variable is higher than all correlations between the latent variables. However, Henseler and colleagues (2015) used simulation studies to demonstrate that discriminant validity is better assessed by HTMT. Garson (2016) suggested that the discriminant validity between two latent variables is assured when HTMT is less than 1 while Henseler *et al*. (2015) identified that if this value is less than

0.90, the discriminant validity will be assured. SmartPLS uses both of these methods of assessing discriminant validity.

Evaluation of Structural models

When the reliability and validity of construct measurements are confirmed, the evaluation of Structural models is implemented by a systematic approach of five steps relating to collinearity issues of the structural model, significance and relevance of the structural model's relationships, explanatory power, predictive power, and model comparisons. In PLS-SEM, researchers can make comparisons of alternative models depending on the research situation. However, model comparisons are not involved in every PLS-SEM analysis, the step of model comparisons is suggested to be optional (Hair *et al.*, 2022). Details of the evaluation of Structural models that are implemented in this study are presented in Table 5.2.

Table 5.2: Evaluation of Structural models

Criterion	**Metrics**	**Thresholds**
Collinearity evaluation	Standardized Root Mean Square Residual (SRMR)	≤ 0.08 or 0.1
Path coefficients of the structural model	Path coefficients	• Closed to +1: strong positive relationships • Closed to -1: strong negative relationships
Coefficient of determination	R^2 values	• 0.75: substantial • 0.5: moderate • 0.25: weak
f^2 effect size	f^2 value	> 0.02: small effect size > 0.15: medium effect size > 0.35: large effect size

Source: Hair *et al*. (2017, 2019)

Firstly, the potential collinearity of the structural model should be examined to ensure that collinearity is not a problem. When the model has collinearity or multicollinearity, the regression coefficients and p-values are distorted, leading to erroneous conclusions about the relationships in the model (Sarstedt and Mooi, 2019). Hair *et al.* (2019) provided VIF value thresholds in assessing collinearity with different value levels. If the VIF value is 5 or above, there is a probability of collinearity among predictor constructs. Collinearity can also occur at lower VIF values of 3-5. Otherwise, there is no collinearity when VIF values are lower than 3. Besides, Henseler *et al*. (2014) affirmed that the SRMR value is "Goodness of fit" in PLS-SEM. This value is measured to avoid model misspecification. According to Hu and Bentler (1999), the SRMR value must be lower than 0.08 or 0.1.

Secondly, the significance and relevance of the structural model relationships are evaluated to assess the hypothesized relationships among the constructs through the path coefficients. The significance of path coefficients depends on bootstrapping standard errors obtained from the bootstrapping method. The bootstrapping standard errors are considered a basis for calculating *t*-values of path coefficients or confidence intervals (Streukens and Leroi-Werelds, 2016). Being used to assess significant levels of the relationship, p-values are suggested to be less than 0.05 to ensure that the correlations are significant at 5%. If the p-values are greater than 0.05, the impact is not statistically significant. In this case, we still keep the relationship in the model and conclude that it is not statistically significant, but do not remove the factor from the model. In terms of relevance, values of path coefficients are often between -1 and +1. According to Hair *et al*. (2017, 2019), the values are closer to -1 presenting strong negative relationships. Otherwise, the values are closer to +1 showing strong positive relationships. The path coefficients above +1 or below -1 may occur when there is a very high level of collinearity. When the path coefficients are unacceptable due to the values higher than +/-1, methods for reducing multicollinearity must be implemented.

Thirdly, the next step of the evaluation is to examine the coefficient of determination (R^2) of the endogenous constructs to measure the predictive power of the model. According to Shmueli and Koppius (2011), the R^2 is representative of the variance of endogenous constructs and measures the explanatory power of the model. The R^2 has a range from 0 to 1 where higher values indicate greater explanatory power. R^2 values of 0.75, 0.50, and 0.25 are considered substantial, moderate, and weak, respectively (Hair *et al*., 2017). However, depending on the research context and in some disciplines, the R^2 is considered satisfactory even if the values are as low as 0.10 (Raithel *et al.*, 2012). R^2 works as a function of many predictor constructs, the greater the number of predictor constructs, the higher the R^2. Therefore, the R^2 is well explained relative to the research context, referencing the R^2 values from related studies and models with the same levels of complexity.

Fourthly, the f^2 effect size is investigated to evaluate the relevant influence of a predictor construct on an endogenous construct from the perspective of explanatory power (Hair *et al*., 2021). f^2 values are useful in assessing the contribution level of the predictor construct to the R^2 value of a target construct in the structural model. Different f^2 values of 0.02, 0.15, and 0.35 present small, medium, and large effects respectively of the exogenous latent variable. The f^2 is valuable to the explanation of selected endogenous constructs from analyzing the relevance of constructs (Hair *et al*., 2017).

6. RESULTS OF INVESTIGATING FACTORS IMPACTING THE TRANSFORMATION INTO 4PL

6.1 Surveyed data analysis

6.1.1 Respondents' information analysis

In Vietnam, most logistics enterprises fall into small and medium size. They operate in a variety of fields depending on their objectives and capabilities as shown in Table 6.1. In this study's list of survey respondents, the highest rate belongs to 90 firms operating in transportation, forwarding, and warehousing, and accounts for 21.74%. The second largest group falls into transportation and warehousing with 81 companies. 14.98% of respondents operate in transportation and forwarding which are very popular in the logistics industry in Vietnam. The next group consists of 60 enterprises that deliver services in different models of transportation. 3PLs account for only 13.29% of total respondents because the number of 3PLs achieves a very low rate in the logistics industry. The remainder of companies providing services in forwarding and warehousing; forwarding; transportation, forwarding, and shipping agency; and forwarding and shipping agency account for 10.39%, 2.17%, 2.17%, and 1.21% respectively.

Table 6.1: Category of survey respondents based on operations

Field of logistics operations	Quantity (firms)	Percentage (%)
Transportation, forwarding, and warehousing	90	21.74
Transportation and warehousing	81	19.56
Transportation and forwarding	62	14.98
Transportation	60	14.49
Third-Party Logistics providers (3PL)	55	13.29
Forwarding and warehousing	43	10.39
Forwarding	09	2.17
Transportation, forwarding, and shipping agency	09	2.17
Forwarding and shipping agency	05	1.21
Total	**414**	**100**

Source: The author's calculations

From the list of survey respondents, it is obvious that many LSPs in Vietnam provide transportation services including 302 out of 414 survey respondents, accounting for 72.94% of the total. Although most logistics enterprises in Vietnam provide forwarding services in their operations, the number of LSPs in the area of forwarding and the area of forwarding and shipping agencies accounts for a very low rate in the list of respondents.

Table 6.2: Category of survey respondents based on location

Location	Quantity (firms)	Percentage (%)
The North of Vietnam	60	14.49
The Central of Vietnam	44	10.63
The South of Vietnam	310	74.88
Total	**414**	**100**

Source: The author's calculations

According to the annual report of Ministry of Industry and Trade of The Socialist Republic of Vietnam (2023), there are over three thousand logistics enterprises that provide diversified logistics services nationwide as presented in Table 6.2. The reported statistics reveal that more than 70% of them are operating in the South of Vietnam. The remaining firms are located in the North and the Central of the country. These statistics can be considered a comprehensive explanation for the rate of 74.88% of survey respondents from the South of Vietnam. The second largest number of respondents comes from the North of Vietnam with 14.49%. The smallest group of answered LSPs which is located in the Central accounts for 10.63%.

6.1.2 Descriptive statistics of the surveyed results

As shown in Table 6.3, the positive results of the survey are illustrated with 414 qualified observations. The data values on the statistical mean range from 2.459 to 3.449 where TRA2 is the only indicator gaining the value of 2.459. This means that the observed LSPs' national and international speed of transportation is at a low level while the mean values of all other indicators reach a medium level. A median value of 3 for most indicators reveals that most respondents choose "Medium" for their answers.

Table 6.3: Descriptive statistics of the survey

Indicators	Observations	Mean	Median	Min	Max	Std. deviation
4PL1	414	3.143	3.000	1.000	5.000	0.762
4PL2	414	3.280	3.000	2.000	5.000	0.731
4PL3	414	3.449	3.000	1.000	5.000	0.835
COM1	414	2.601	3.000	1.000	5.000	0.932
COM2	414	2.722	3.000	1.000	5.000	0.999
COM3	414	2.780	3.000	1.000	5.000	1.064
HRM1	414	3.300	3.000	1.000	5.000	0.894
HRM2	414	3.167	3.000	1.000	5.000	1.011
HRM3	414	3.234	3.000	1.000	5.000	1.034
INF1	414	2.577	3.000	1.000	5.000	0.864
INF2	414	2.633	3.000	1.000	5.000	0.983
INF3	414	2.744	3.000	1.000	5.000	1.013
ITA1	414	3.193	3.000	1.000	5.000	0.852
ITA2	414	3.312	3.000	1.000	5.000	0.897

ITA3	414	3.415	3.000	2.000	5.000	0.951
LOS1	414	3.350	3.000	1.000	5.000	0.896
LOS2	414	3.200	3.000	1.000	5.000	0.959
LOS3	414	3.227	3.000	1.000	5.000	1.015
OUT1	414	3.043	3.000	1.000	5.000	0.785
OUT2	414	3.034	3.000	1.000	5.000	0.807
OUT3	414	2.831	3.000	1.000	5.000	0.752
POL1	414	3.060	3.000	1.000	5.000	0.950
POL2	414	3.043	3.000	1.000	5.000	0.947
POL3	414	3.246	3.000	1.000	5.000	0.982
TRA1	414	2.882	3.000	1.000	5.000	0.836
TRA2	414	2.459	2.000	1.000	5.000	0.769
TRA3	414	2.896	3.000	1.000	5.000	0.852
WOP1	414	3.007	3.000	1.000	5.000	0.858
WOP2	414	2.932	3.000	1.000	5.000	0.933
WOP3	414	2.918	3.000	1.000	5.000	0.910

Source: The author's estimations from SmartPLS

Regarding standard deviation, this concept can be explained as a statistical measure of the dispersion of data points around the mean. The coefficient of variation represents the ratio of the standard deviation to the mean. In the above research results, all of the standard deviation values are lower than the mean values. Therefore, the indicators' values of the coefficient of variation are lower than 1. This indicates a lower spread of data values relative to the mean.

6.2 Evaluation of Measurement and Structural Models

6.2.1 Evaluation of Measurement Models

After establishing the model and evaluating all defined factors in the model, a comprehensive analysis and assessment are essential to systematically perform for the affirmation of the research results. Figure 6.1 presents the relationships between variables, so-called constructs, of the model and the significance of indicators to such factors. Values that are shown for each factor indicate their impact on the transformation into 4PL of LSPs in Vietnam.

Based on the recommendations of PLS-SEM theory and the literature of Hair *et al*. (2017), the constructs' reliability is evaluated by using Dijkstra-Henseler's rho-A along with Cronbach's alpha coefficients. As shown in Table 7.1, all values exceed the thresholds of rho-A as 0.70 - 0.95 and Cronbach's alpha as 0.60 – 0.95 and indicate strong coefficients of the construct's reliability as suggested by Bagozzi & Yi (1998) and Hair *et al*. (2019). Almost all scales meet the threshold of 0.70, as recommended by Hair *et al*. (2017, 2019), except for TRA2 - Speed of transportation nationally and internationally with outer loadings of 0.511. As a result, this indicator is concluded to be not consistent with others and can not measure the construct TRA. After indicator TRA2 is eliminated, the convergent validity of the conceptual model is evaluated due to the satisfaction of other indicators to the thresholds.

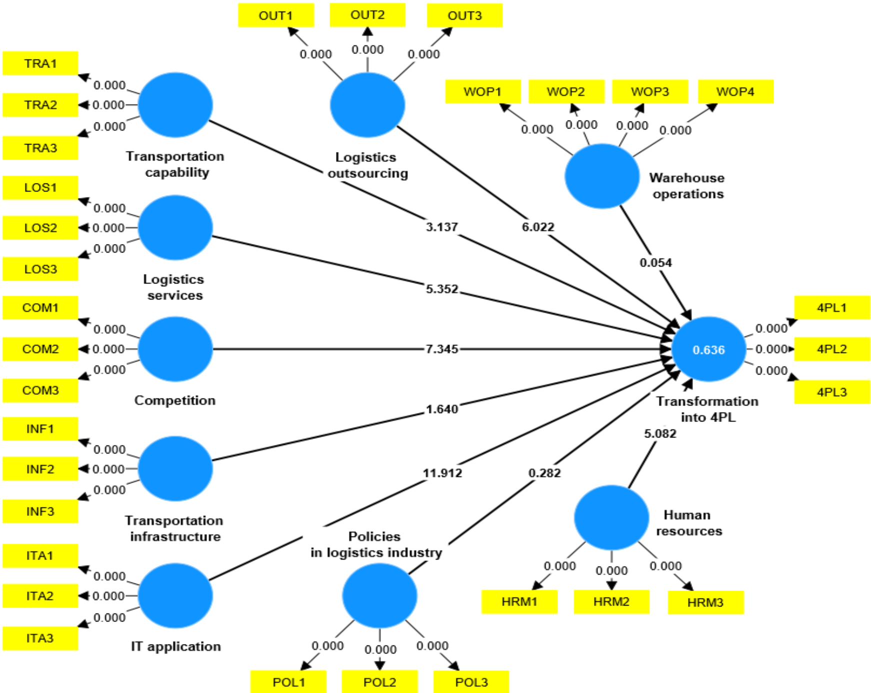

Figure 6.1: Model of transformation into 4PL

Source: The author's estimations from SmartPLS

Regarding indicator loadings of latent constructs, the reliability of indicators must gain Outer Loadings higher or equal to the threshold of 0.50 to meet the standard of reliability. Composite reliability must be higher or equal to 0.70 (Hulland, 1999). All items in the model are loaded meaningfully and satisfactorily to their corresponding constructs. Values are presented in Table 6.4.

Table 6.4: Consistency Reliability and Convergent Validity

Construct	Indicator	Outer Loadings	Dijkstra-Henseler's rho_A	Cronbach's alpha(α)	Composite Reliability	Average Variance Extracted (AVE)
4PL	4PL1	0.801	0.768	0.767	0.866	0.683
	4PL2	0.833				
	4PL3	0.843				
COM	COM1	0.953	0.891	0.886	0.930	0.816
	COM2	0.871				
	COM3	0.884				
HRM	HMR1	0.950	0.887	0.878	0.925	0.806
	HMR2	0.861				
	HMR3	0.879				

INF	INF1	0.865	0.875	0.864	0.916	0.785
	INF2	0.909				
	INF3	0.884				
ITA	ITA1	0.958	0.909	0.896	0.936	0.829
	ITA2	0.883				
	ITA3	0.889				
LOS	LOS1	0.960	0.912	0.894	0.934	0.825
	LOS2	0.870				
	LOS3	0.893				
OUT	OUT1	0.799	0.717	0.713	0.839	0.634
	OUT2	0.826				
	OUT3	0.763				
POL	POL1	0.857	0.891	0.872	0.921	0.795
	POL2	0.926				
	POL3	0.891				
TRA	TRA1	0.929	0.805	0.715	0.847	0.662
	TRA2	0.511				
	TRA3	0.928				
WOP	WOP1	0.940	0.920	0.907	0.935	0.783
	WOP2	0.857				
	WOP3	0.850				
	WOP4	0.890				

Source: The author's estimations from SmartPLS

Convergent Validity is used to evaluate the stability of scales. Fornell and Larcker (1981) pointed out that the Average Variance Extracted (AVE) must be higher or equal to 0.50 to indicate satisfactory convergent validity. Constructs in the study have minimum to maximum values from 0.634 to 0.829. Therefore, these values are satisfactory. The details are stated in Table 6.4.

Discriminant Validity assessment aims to ensure that a reflective construct has stronger relationships with its indicators than those of any other construct in the PLS path model (Hair *et al.*, 2022). The greater the average correlation coefficient within a scale compared to the average cross-correlation coefficients, the better the results. If the average of cross-correlation coefficients is lower, it means that the latent variable mentioned above shares less variation with other latent variables. Then, the indicators in the two latent variables will achieve discriminant validity. With such a distinctiveness assessment, the HTMT criterion is recommended for implementation. Discriminant validity has been established between two reflectively measured constructs when the HTMT value is less than 0.90.

Table 6.5: Discriminant Validity (Heterotrait-Monotrait Ratio of Correlations - HTMT)

Construct	COM	HRM	ITA	OUT	LOS	POL	4PL	TRA	INF	WOP
COM										
HRM	0.125									
ITA	0.139	0.246								
OUT	0.220	0.158	0.141							
LOS	0.084	0.313	0.225	0.134						
POL	0.171	0.315	0.304	0.257	0.342					
4PL	0.509	0.404	0.331	0.568	0.532	0.721				
TRA	0.249	0.450	0.359	0.318	0.499	0.401	0.619			
INF	0.260	0.084	0.271	0.303	0.059	0.118	0.411	0.163		
WOP	0.215	0.415	0.282	0.203	0.422	0.286	0.455	0.636	0.226	

Source: The author's estimations from SmartPLS

As shown in Table 7.5, the values of constructs in the model range from 0.125 to 0.721. In other words, the HTMT values of variables are below 0.90. These results certify that the discriminant validity of the measurement models is validated.

6.2.2 Evaluation of Structural Models

As presented in the research methodology, the evaluation of Structural Models concentrates on Collinearity evaluation, Path coefficients, Coefficient of determination, and f^2 effect size. Firstly, the collinearity of the model is examined to identify whether there is a collinearity or multicollinearity. VIF values are considered to assess the probability of collinearity among latent constructs (Sarstedt and Mooi, 2019). Among the three measurement scales recommended by Bollen (2011), reflective measurement is the best choice for the research context. Therefore, it is essential to evaluate the inner VIF values while the assessment of outer VIF values is not necessary. As shown in Table 6.6, all inner VIF values are lower than 3 which means that there is no collinearity in the structural model.

Table 6.6: Inner VIF values

Metrics	**Estimated model**	**Remarks**
COM => 4PL	1.111	*Satisfactory*
HRM => 4PL	1.172	*Satisfactory*
ITA => 4PL	1.262	*Satisfactory*
OUT => 4PL	1.131	*Satisfactory*
LOS => 4PL	1.323	*Satisfactory*
POL => 4PL	1.190	*Satisfactory*

TRA => 4PL	1.633	*Satisfactory*
INF => 4PL	1.266	*Satisfactory*
WOP => 4PL	1.594	*Satisfactory*

Source: The author's estimations from SmartPLS

To measure the appropriate level of the model for the research context, the Standardized Root Mean Square Residual (SRMR) value is considered. Based on the thresholds of the SRMR value stated by Hu and Bentler (1999) as lower than 0.08 or 0.1 and the affirmation of Henseler *et al*. (2014) in the SRMR value as "Goodness of fit" in PLS-SEM, the SRMR value of this structural model is measured to avoid model misspecification. Table 6.7 shows the SRMR value of the research model as 0.049. It demonstrates the fitness of the model.

Table 6.7: Standardized Root Mean Square Residual (SRMR)

	Original sample (O)	**Sample mean (M)**	**95%**	**99%**
Saturated Model	0.049	0.034	0.037	0.038
Estimated Model	0.049	0.034	0.037	0.038

Source: The author's estimations from SmartPLS

Secondly, the hypothesized relationships among the constructs are assessed through the path coefficients. When t-value is higher than 1.96, it means that the significant level is lower than 5% (p-value < 0.05). Outer Weights are criteria showing the relative contribution of each indicator. In the Structural Equation Model (SEM), Outer Weights are often lower than Outer Loadings (Hair *et al*., 2014). To evaluate whether indicators contribute to the establishment of latent variables, bootstrapping should be used. In this study, the author uses the software SmartPLS 3 to build a Structural Equation Model with 5,000 bootstrap samples.

However, Anderson and Gerbing (1988) stated that SEM requires a large number of samples and consumes much time and costs for researchers. Schumaker and Lomax (2016) assumed that bootstrapping is appropriate to apply due to its repeated sample method while initial samples are major parts. The bootstrapping method uses the obtained sample data from the study to resample it various times to create many simulated samples. In the bootstrapping procedure, sampling distributions are considered the foundation for confidence intervals and hypothesis testing. t-value is calculated based on the distributions of created samples.

Table 6.8: Path Coefficient and Construct Relationships

Effect	**Bootstrapping results**	**Empirical remarks**

	Original Coefficient	*Mean value*	*Standard deviation*	*t-value*	*p-value*	
COM → 4PL	0,244	0,245	0,033	7,345	0,000	***Supported***
HRM → 4PL	0,165	0,165	0,032	5,082	0,000	***Supported***
ITA → 4PL	0,384	0,383	0,032	11,912	0,000	***Supported***
OUT → 4PL	0,208	0,209	0,035	6,022	0,000	***Supported***
LOS → 4PL	0,208	0,208	0,039	5,352	0,000	***Supported***
TRA → 4PL	0,127	0,127	0,040	3,137	0,002	***Supported***
POL → 4PL	-0,009	-0,008	0,031	0,282	0,778	*Not supported*
INF → 4PL	0,056	0,056	0,034	1,640	0,101	*Not supported*
WOP → 4PL	-0,002	-0,002	0,038	0,054	0,957	*Not supported*

Source: The author's estimations from SmartPLS

From the bootstrapping results in Table 6.8, the impact of six factors including COM, HRM, ITA, OUT, LOS, and TRA is definitely demonstrated with p-values under the threshold. The three remaining factors of POL, INF, and WOP are not statistically significant due to their p-values over 0.05. For investigating the relevance of the structural model relationships, most of the values of path coefficients are closer to +1, except for POL and WOP. As a result, constructs in the structural model, in general, show strong positive relationships. The values of POL and WOP are not below -1 because there is no collinearity in the model. Therefore, the reduction of multicollinearity is not necessary.

Thirdly, the examination of the reliability of the research model is the next step of the evaluation. Being known as the coefficient of determination, R Square defines the degree to which the variance in the dependent variable can be explained by independent variables. From the results of bootstrapping, the R Square of the model is 0.644, and the R Square Adjusted is 0.636 (as shown in Figure 7.1). It means that 63,6% of the variation in the dependent variable (4PL) is explained by independent variables (TRA, ITA, HRM, LOS, COM, OUT, WOP, INF, and POL). With this result, the reliability of the research model is demonstrated. The R^2 is satisfactory in measuring the explanatory power of the model.

Fourthly, Hair *et al*. (2021) suggested investigating the f^2 effect size to assess the contribution level of independent variables to the dependent construct with different values of 0.02, 0.15, and 0.35 presenting small, medium, and large effects respectively. Table 6.9 illustrates the levels of effect size of nine factors to

4PL. Specifically, COM and ITA have medium effects to 4PL while HRM, OUT, LOS, and TRA impact at a small level. The f^2 values of the three remaining variables including INF, POL, and WOP show a very small effect and no effect on the dependent factor of 4PL.

Table 6.9: f2 effect size of constructs in the structural model

Metrics	Estimated model	Remarks
COM => 4PL	0.150	*Medium effect*
HRM => 4PL	0.065	*Small effect*
ITA => 4PL	0.327	*Medium effect*
OUT => 4PL	0.107	*Small effect*
LOS => 4PL	0.092	*Small effect*
POL => 4PL	0.000	*No effect*
TRA => 4PL	0.028	*Small effect*
INF => 4PL	0.007	*Very small effect*
WOP => 4PL	0.000	*No effect*

Source: The author's estimations from SmartPLS

From the analyses and evaluations of the Measurement models and Structural models as stated above, the results of hypothesis testing can be affirmed on the significance and effect of each variable in the conceptual model. The evidence from the bootstrapping procedure shows that six constructs have positive effects on Transformation into 4PL (4PL) including Competition in the logistics industry (COM), Human resources (HRM), IT application (ITA), Logistics outsourcing (OUT), Logistics services (LOS), and Transportation capability (TRA). ITA has the strongest impact while TRA has the weakest influence on 4PL. Otherwise, Policies in the logistics industry (POL), Transportation infrastructure (INF), and Warehouse operations (WOP) negatively impact Transformation into 4PL (4PL) due to their p-values equal to 0,778; 0,101; and 0,957 respectively. As a result, it may be interpreted that hypotheses 1, 3, 4, 5, 7, and 8 are supported and hypotheses 2, 6, and 9 aren't supported. From such results, three variables of WOP, POL, and INF are eliminated from the model, structural equation modeling has been assessed again to affirm the results of the research. Although previous studies showed the importance and role of warehouse operations, transportation infrastructure, and policies in the logistics industry to the transformation into 4PL, they aren't significant in the context of local LSPs in Vietnam. In summary, the research findings explain the influence of determinants including ITA, LOS, OUT, TRA, HRM, and COM on the transformation into 4PL.

7. DEVELOPMENT STRATEGIES THROUGH THE APPLICATION OF TRIZ INNOVATIVE APPROACH

Based on the identified capabilities of 4PL under the studies of Porter (1996), Walters and Rainbird (2007), Frost and Sullivan (2014), Fulconis *et al*. (2006), Rajaguru and Matanda (2013), and the above results, innovative recommendations are established for the development into 4PL of local LSPs in Vietnam under the implementation of TRIZ inventive approach. The three mentioned core capabilities of 4PL are considered problems that local LSPs must identify contradictions and determine relevant innovative solutions.

TRIZ implementation to the first attribute - "Value chain creation"

Stage 1: Identifying the capability

Walters and Rainbird (2007) outlined the process of making a value chain for companies to be predominant to their competitors. Beneath expanding expectations of the value chain, Bowersox (2013) asserted that integrated service providers started to launch into the market a range of logistics services. Korpela *et al*. (1996) pointed out that the provision of value-added services to customers is recognized as a core successful element in value creation. Therefore, the wide range and added value of logistics services become key components in creating value for clients.

Stage 2: Determining the improving and worsening parameters

From the viewpoint of clients, they desire to get great choices of offers and demand high-quality services. However, 4PL must pay consideration to the balance between the quality and benefits of offered services to costs that customers suffer to reach their goals. To effectively complete the important role of granting value to clients, 4PL utilizes all of its resources from its own and best-added value providers simultaneously. In TRIZ 39 engineering variables, "Reliability" which is explained as "A system's ability to perform its intended function in predictable ways and conditions" significantly influences the effectiveness of value chain creation. As a result, the improving parameter for value chain creation is "27- Reliability". In line with satisfying the reliability requirement, 4PL must make partial or total changes to the system for a short or long time. Therefore, the worsening parameter can be regarded as "26- Quantity of substance/the matter" which is described as "The number or amount of a system's materials, substances, parts or subsystems which might be changed fully or partially, permanently or temporarily".

Stage 3: Studying innovative principles

According to the improving parameter "27- Reliability" and the worsening parameter "26- Quantity of substance/the matter", innovative principles of this logistics capability corresponding to the contradictory matrix are "Principle 21-

Skipping, Principle 28- Mechanics substitution, Principle 40- Composite materials, and Principle 3- Local quality". From careful consideration of various aspects, "Principles 21, 28, 40, and 3" may contribute to LSPs in value chain creation in the development into 4PLs. Therefore, all of them are chosen for developing strategies.

Stage 4: Formulating strategies based on defined innovative principles

"Principle 21- Skipping" mentions the implementation of the process at high speed. One of the key characteristics of 4PL is to supply logistics services in an effective and timely manner. 4PL providers mainly concentrate on the role of granting value to the organizational clients through collaborated resources supplied by the selected superior providers with cost-effectiveness. Therefore, the improvement of process speed within the logistics operations can be considered a key indicator for LSPs in the transformation into 4PL.

"Principle 28- Mechanics substitution" consists of sub-principles as follows:

- "Replace a mechanical means with a sensory means": LSPs, instead of simply providing logistics services, should create and deliver values to their clients to make essential changes to the degree of flexibility to strengthen the level of customization on logistics services.
- "Use electric, magnetic, and electromagnetic fields to interact with the object": technology is, nowadays, recognized as a key tool that LSPs should utilize to improve the quality of logistics services. ICT could be useful for the performance of activities and the execution of decision-making more quickly to gain higher efficiency in logistics services.
- "Change from static to movable fields, from unstructured fields to those having the structure": LSPs should transform the service provision from supplying designed logistics services such as transportation and warehousing to dealing with clients in the manner of partnership for long-term contracts.

"Principle 40- Composite materials lead to the change from uniform to composite services": Working as an integrator, 4PL combines logistics services from multiple 3PL providers and generates comprehensive strategies for the clients. Therefore, it is essential for LSPs to upgrade their logistics services to integrated logistics solutions for the whole supply chain instead of providing separate offers to create more benefits and value for clients.

"Principle 3- Local quality" mentions three following strategies:

- "Change an object's structure from uniform to non-uniform, change an external environment (or external influence) from uniform to non-uniform": LSPs must be able to expand their service range and offer great customization schemes if they desire to operate as 4PLs.
- "Make each part of an object function in conditions most suitable for its operation": 4PL offers clients an abundant service range of logistics

operations at three levels including transactional logistics services, tactical logistics services, and strategic logistics services.

- "Make each part of an object fulfill a different and useful function": "Logistics involves getting, in the right way, the right product, in the right quantity and right quality, in the right place at the right time, for the right customer at the right cost" (Mangan *et al.*, 2008). 4PL must ensure all of these functions are controlled effectively.

TRIZ implementation to the second attribute - "Integration of multiple 3PL providers' activities"

Stage 1: Identifying the capability

Cost-effectiveness accompanying qualified logistics services is considered one of the main objectives of 4PL's business. 4PLs are always excellent in indicating their ability to develop and manage the logistics networks with strong cooperation with 3PLs and firms providing the latest logistics IT services (Gattorna, 1998). As a result, the concentration on the diversity of relationships is essential to 4PL when coordinating with partners to create a comprehensive supply chain network.

Stage 2: Determining the improving and worsening parameters

To successfully assemble the resources, capabilities, and technology to design, produce, and operate comprehensive supply chain solutions, 4PL needs to improve its service in terms of broad and deep scope to be adaptive to 4PL's characteristics. From the above-mentioned analyses, the improving parameter is determined as "36- Device complexity". According to the explanation of 39 parameters of the contradiction matrix, Device complexity is referred to as "the number and diversity of elements and element interrelationships within a system". However, the management of coordinated activities and resources from partners becomes more complicated when 4PL operates as an integrator of breakthrough supply chain solutions. As a result, the worsening parameter is regarded as "37- Difficulty in detecting and measuring". From the description of parameter 37 stated in the contradiction matrix, it takes a lot of time to set up and implement complex and costly systems or systems that have complex relationships between components or components that interfere with each other.

Stage 3: Studying innovative principles

According to the improving parameter "36- Device complexity" and the worsening parameter "37- Difficulty in detecting and measuring", innovative principles of logistics capability corresponding to contradictory matrix consist of "Principle 15- Dynamics, Principle 10- Preliminary action, Principle 37- Thermal expansion, and Principle 28- Mechanics substitution". After being seriously investigated identified innovative principles, "Principles 15 and 10" are adopted to generate strategies. "Principle 37" is more suitable for engineering activities while "Principle 28" has already been applied in previous capability.

Stage 4: Formulating strategies based on defined innovative principle

"Principle 15- Dynamics" recommends three strategies for creating the innovation of 4PL's integrated logistics services. Firstly, LSPs that are in the process of transforming into 4PLs should build the optional collaboration system in their logistics networks for partners including 3PLs and enterprises supplying IT solutions. Secondly, all components in the integrated logistics services can be redesigned or exchanged within the network in terms of assuring the 4PL's prime goals of effective operations and cost reduction. Thirdly, the external business environment constantly fluctuates and makes certain influences on customers' demands. As a result, a diversity of flexible customized solutions should be offered to clients to catch up with their adaptive business strategies.

"Principle 10- Preliminary action refers to the process of pre-actions adding to the service system". It is essential that customers are provided the complete logistics plan for their company's business from starting the transaction in which all participating components of the supply chain are presented. The pre-arrangement would be useful for both 4PLs and the customers in negotiating to reach an agreement on large projects. Such preliminary action also creates the activeness for 4PLs to adjust components in the supply chain solutions to make the trade-off between the benefits of all related partners and cost assumptions.

TRIZ implementation to the third attribute - "Management of global supply chain"

Stage 1: Identifying the capability

In the global supply chain, ranges of operations are complicated and the requirements for effective management are at a high level. As a result, 4PLs must have the ability to connect different resources and effectively control management capability in every stage of a global supply chain such as designing, constructing, and running the whole process. With the global scope of operations, 4PLs serve a huge number of clients all over the world in flexible approaches. Therefore, adaptability is the key factor for global supply chain management.

Stage 2: Determining the improving and worsening parameters

Regarding the scope of activities, 4PLs build broad logistics networks around the world to promote their global operations. Their monitoring of compositions in the network becomes especially important. As a result, 4PLs need to focus on adaptability and flexibility within the integrated logistics projects to be adaptive to the fluctuations in the external environment. From such detailed analyses, the improving parameter is regarded as "35- Adaptability". This improving parameter is described as "the extent to which a system positively responds to external changes, also a system that can be used in multiple ways for under a variety of circumstances". However, when the logistics service system becomes flexible to be responsive to specific features of definite projects, the stability of the network may be impacted in composition. Elements of the system embrace the motion towards common trends and transition all over the world. Therefore, the worsening parameter is defined as “13- Stability of the object’s composition”. This parameter mentions the integrity of the logistics service system and the relationship between the system’s constituent elements.

Stage 3: Studying innovative principles

According to the improving parameter “35- Adaptability” and the worsening parameter “13- Stability of the object’s composition”, innovative principles of logistics capability corresponding to the contradictory matrix are “Principle 35- Parameter changes, Principle 30- Flexible shells and thin films, and Principle 14- Spheroidality – Curvature”. From the formal thorough examination of these parameters and concerning innovative directions of these principles, “Principle 30 and Principle 14” are specifically applied to the engineering area. As a result, “Principle 35- Parameter changes” are selected to develop strategies for the transformation.

Stage 4: Formulating strategies based on defined innovative principle

“Principle 35- Parameter changes” leads to three tactics that support the improvement of global SCM. Firstly, the status of the international logistics network needs to be flexible to meet the diversified demands of clients’ customized contracts in every market in the world. Secondly, the focus on core elements of the logistics service system should be flexibly changed in terms of the capability and compatibility of participating partners in the network. In the global supply chain, many 3PLs are responsible for supplying plenty of complicated logistics activities to create integrated strategic solutions for customers. Specifically, the second tactic for “Principle 35” suggests that “4PLs’ global supply chain management becomes more effective for both provider and customer when there is more participation of 3PLs and IT service firms”. In this case, 4PLs may take advantage of partners’ specified strengths to maximize benefits and decrease costs. Thirdly, the changes in the flexibility level of operations in the logistics system should be made corresponding to specific situations consisting of characterized clients, specialized operations, definite periods, and defined markets.

Strategy summary

From the transparent evidence of analyses and comparisons between LSP and 4PL, it is obvious to assert that 4PL is superior and brings greater value to customers. Therefore, the establishment of strategies for the transformation into 4PL is essential to meet high levels of requirements from customers. Suggested solutions are built from the foundation of 4PL’s three capabilities including value chain creation, integration of multiple 3PL provider activities, and management of the global supply chain under the application of TRIZ inventive approach.

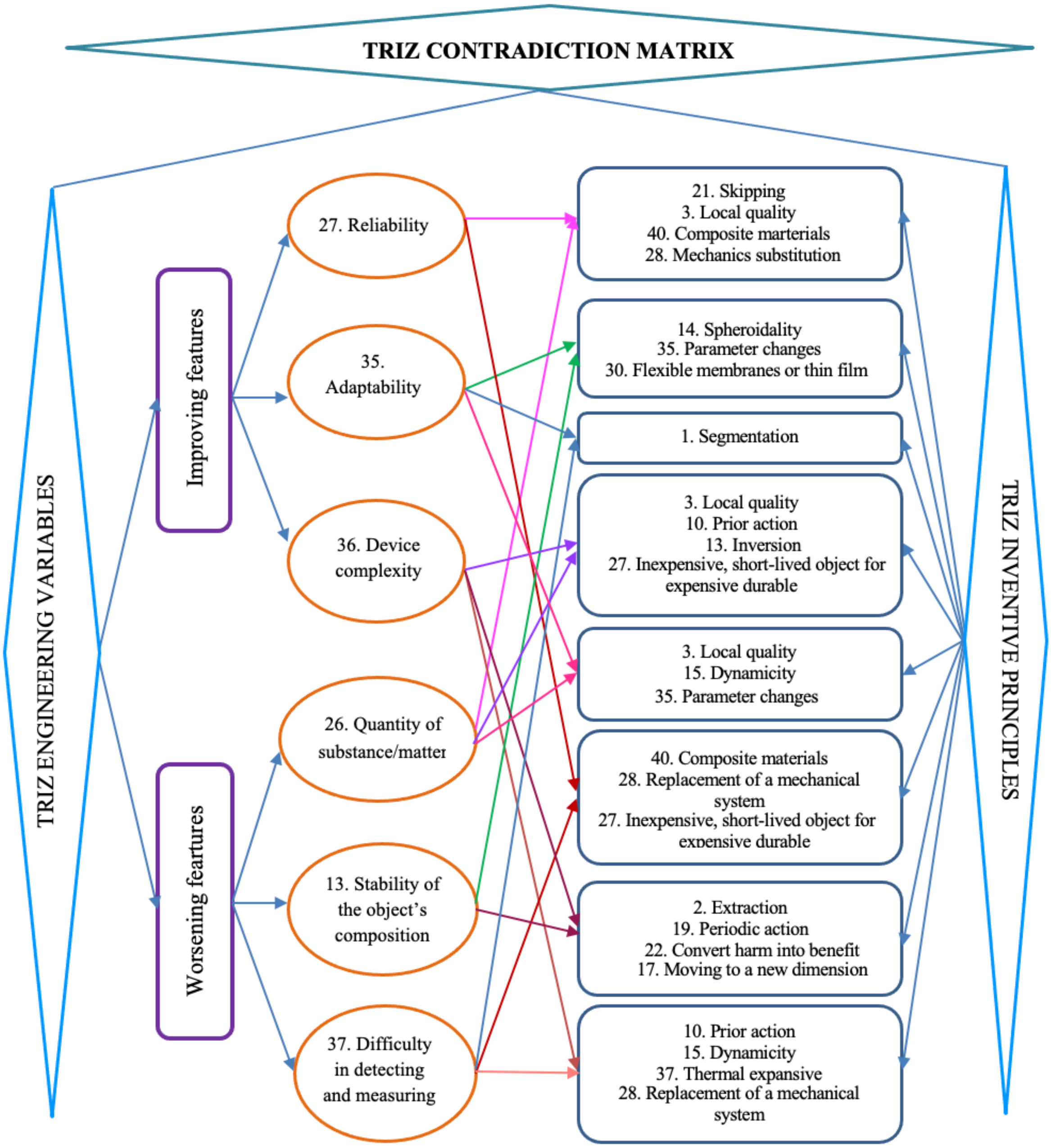

Figure 7.1: Suggested strategies constructed under TRIZ application

Source: The author's study

From the implementation process of analyzing and solving problems under the TRIZ contradictory matrix, seven innovative strategies are developed to improve LSP's logistics operations. They are categorized into two groups including short-term and long-term strategies. Three strategies among seven ones are recommended to perform in a short time. The remaining 4 strategies shall be appropriate to execute over a long time.

8. CONTRIBUTIONS

8.1 Contribution for science

Through the research results, the dissertation would have the following contributions:

- The study systemizes general theories in 4PL providers, transportation capability, warehouse operations, IT application, human resources in logistics service, logistics services, transportation infrastructure, logistics outsourcing trend, competition in the logistics market, policies in the logistics industry, value chain creation, integration of multiple 3PL providers' activities, global supply chain management, and TRIZ theory. Therefore, the study will provide significant contributions to the completion of the theoretical framework in 4PL services.
- The study would contribute to the measurement system in variables influencing the strategic transformation into 4PL of LSPs.
- The study suggests the application of TRIZ inventive approach for establishing development strategies for LSPs to transform into 4PL.

8.2 Contribution for practice

This study will be helpful for managers of LSPs in Vietnam and practitioners to enhance their capabilities for the strategic transformation into 4PL. Through the utility of their resources and the integration of others, LSPs can gain a competitive advantage in the global ever-increasing logistics market. The logistics industry in Vietnam has a high growth potential and benefits thanks to Vietnam's favorable strategic position in the Asian area. If local logistics enterprises optimize their logistics services, they will create value for their clients with effective costs. In this case, local LSPs perform their role by combining process, technology, and management to provide breakthrough solutions and maximum benefits to customers (Gattorna J., 1998; Mukhopadhyay, 2006).

9. CONCLUSIONS

The findings of this study which are analyzed and discussed above affirm that the study has achieved the following results:

Firstly, all of the established research objectives have been totally reached with demonstrated results. With the first objective, the author has systemized theories in 4PL to create the foundation for constructing the model. Detailed results from the SmartPLS model have pointed out that the constructed model is comprehensive and meaningful. Then, feasible and innovative strategies have been developed logically and completely.

Secondly, the study has specifically presented the answers to three research questions. The mentioned superior benefits and advantages of 4PL have shown the reasons why local LSPs in Vietnam should transform into 4PL.

Thirdly, after being tested by structural equation modeling, hypotheses H1, H3, H4, H5, H7, and H8 have a positive impact on the strategic transformation into 4PL of local LSPs in Vietnam. Three hypotheses that don't support the transformation process into 4PL of LSPs include H2, H6, and H9. Although these variables also play an important role in logistics providers, the impact isn't shown clearly in the results of this study.

In summary, the research points out determinants impacting the transformation into 4PL of local LSPs based on the collected data from the survey of 414 local LSPs in Vietnam. However, further empirical research should consider the scale of local LSPs which leads to the impact of constructs on the transformation into 4PL. Factors may have significant differences in the effect to LSPs at the variant size. Hence, the type of operations and size of LSPs should be noticed when selecting respondents for the survey to collect data for the model.

Another limitation of this study is that the findings could explain 63.6% of the variation of transformation into 4PL. Six constructs that have direct and positive impacts including ITA, LOS, OUT, COM, TRA, and HRM could interpret 63.6% of the research. In reality, there may be other factors influencing the transformation into 4PL of local LSPs but they aren't assessed in this study due to the limitation of respondents. Further research should enlarge the survey scale to widely perform the assessment. For instance, enterprises that have high potential in development into 4PL account for a low rate of respondents such as 3PL and shipping agencies. Besides, the type of company and financial potential of LSPs may be significant and have remarkable impacts on the transformation into 4PL. As a result, these factors should be seriously considered in future research to have a completed investigation.

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