EFFICIENT TRANSPOTATION CONNECTIVITY BETWEEN THAILAND AND YUNNAN ALONG NORTH-SOUTH ECONOMIC CORRIDOR OF GMS

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A Thesis Submitted to the Graduate School of Naresuan University
in Partial Fulfillment of the Requirements
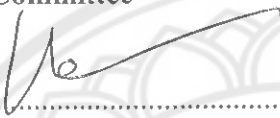for the Doctor of Philosophy Degree in Logistics and Supply Chain
May 2017

Thesis entitled "Efficient Transportation Connectivity between Thailand and Yunnan along North-south Economic Corridor in GMS"

by Yuanchun Xia

has been approved by the Graduate School as partial fulfillment of the requirements for the Doctor of Philosophy Degree in Logistics and Supply Chain of Naresuan University

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ACKNOWLEDGEMENT

First and foremost, I would like to show my deepest gratitude to my supervisor, Dr. Boonsub Panichakarn, a respectable, responsible and resourceful scholar, who has provided me with valuable guidance from the very beginning of my study, in every stage of the writing of this thesis and in each process from literature review to the completion of this thesis. Without his impressive kindness and patience, his consideration and supports, his enlightening instruction, I could not have completed my thesis. His keen and vigorous academic observation enlightens me not only in this thesis but also in my future study. Further, I have been deeply impressed by his attitude towards academic research—seriousness, objectiveness, responsibilities and diligence, which has been a valuable treasure of my life and deserves me to learn in my future life. He is not only an academic scholar guiding my study, but also a senior who has been role-model for me on how to be a real man.

Also, I shall extend my thanks to my co-advisor Dr. Sahas Bunditkul for his continuous help and supports as well as consideration. As an experienced scholar, he has given me valuable and precise suggestions and experience for the thesis, which has guided me in thesis' writing effectively. As a senior teacher with noble personality, Dr. Sahas Bunditkul has been very patient with, kind for, tolerant towards me all the time, by which I have been deeply encouraged and moved many times.

Further, I would like to express my sincere gratitude to General Dr. Montri Supaporn for his valuable comments and suggestions for my thesis. Besides, what I am luckily get from General Dr. Montri Supaporn is his kind encouragement and great supports, which has inspired me to challenge any difficulty in writing this thesis.

In addition, I am grateful to Dr. Kullapa Soratana for her kindness and patience for my life in Thailand and for my thesis. With her professional suggestions and questions, I could finally stick to the points in this research.

Still, I would also like to thank all my teachers, Dr. Kerati Kijmanawat and Dr. Thammanoon Hengsadeekul, who have helped me to develop the fundamental and essential academic competence in each seminar. My sincere appreciation also goes to all other faculty members in School of Logistics and Supply Chain, Naresuan

University, who have make a lot efforts to facilitate my study and helped me at my convenience.

The same gratitude also goes to my working college, Oxbirdge College, Kunming University of Science and Technology, especially to the President Professor Guangzhou Zhao for his kind illumination, firm support and inspiration and kind concern. Without his enlightenment, I may deviate from what a real lecture should be equipped with; without his firm support, I could not imagine how difficult I may encounter from applying for this opportunity to the finalizing the study; and without his inspiration and kind concern, it is impossible for me to undertake my study of doctoral degree in the last three years smoothly.

Unforgettably, I genuinely appreciate all the respondents in the interview for their selfless supports and share of practical experience, which add more objectiveness and feasibility to my thesis, an indispensable part in my research.

Special thanks also go to my friends in NU, for their kind and great help for my study and lives, which is my great gains in Thailand.

Last but not least, I could not forget to show my deepest gratitude to all my family, especially my mother Miss Xiuying Wu, my father Mr. Qingrong Xia, my husband Mr. Jie Chen and my two elder brothers Mr. Hongping Xia and Yong Xia. Without your whole-hearted understanding and supports, I could not make the first step to my dream; without your elaborate efforts for every trifle each day, I could not imagine how I could concentrate on my study. Actually, no words could carry my love and thanks for them. At the same time, my lovely daughter Tian Xia and son Xuan Lunchen are who I should be gratitude for their understanding and guilty due to my occasional absence from a mother's position. And I hope I could be a hard-working example better than precept for them.

Yuanchun Xia

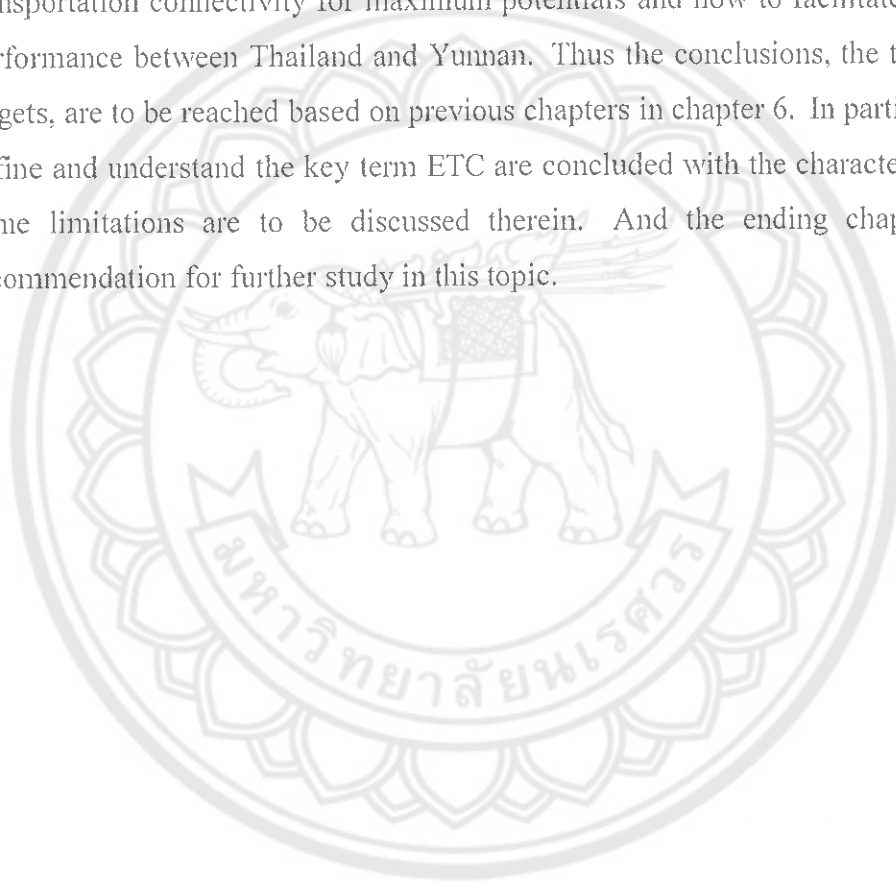|	
Title	EFFICIENT TRANSPORATAION CONNECTIVITY BETWEEN THAILAND AND YUNNAN ALONG NORTH-SOUTH ECONOMIC CORRIDOR OF GMS
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Academic Paper	Thesis Ph.D. in Logistics and Supply Chain, Naresuan University. 2016
Keywords	Efficient transportation connectivity, North-South Economic Corridor, Logistics performance, Potentials, Determinants

ABSTRACT

This dissertation aims to find measurable and solvable solutions from the new approach with regard to the efficient transportation connectivity between Thailand and Yunnan along NSEC of GMS. As a flagship cross-national program of GMS, the North-south Economic Corridor has been witnessed the completion of physical/ hardware connectivity. This corridor, however, has confronted with an embarrassing situation, physically connected but actually blocked in some nodes. Such phenomenon has obviously frustrated the trade and social economic development along this corridor. Thus members of economies, Thailand, Yunnan and Lao, due to their internal needs for external economic development in foreign trade with reliance on this corridor to a great extent, have to face the general concern about how to settle the existing challenges to the efficient transportation connectivity along NSEC of GMS.

The dissertation is organized as follows. Chapter 1 presents the general introduction about the background, objectives, importance, scope, and key terms in this thesis and the conceptual framework for this research. For the originality of this thesis, a systematically literature reviews is given in chapter 2 for getting out the innovative of the study in both theory and practice from the perspectives of connectivity in hardware infrastructure and software infrastructure as well as the logistics performance along NSEC via chronological order and bibliometric perspective. Followed chapter 3 discusses the methodologies from both quantitative approaches and qualitative perspectives. the former of which aims to an assessment of logistics performance along

NSEC and make a cargo volume predication and the latter qualitative interview is to complement the former in objectiveness and comprehensiveness. Data required are introduced and input in models in chapter 4, the results of which are presented through the time-cost model and fuzzy linear regression, respectively. Besides, the interview is concluded in both sides, the logistics performance and potentials of this corridor. Based on this chapter, challenges in impediments and constraints are analysed accordingly in chapter 5 and proposed with measures of how to make the NSEC become an efficient transportation connectivity for maximum potentials and how to facilitate the logistics performance between Thailand and Yunnan. Thus the conclusions, the three research targets, are to be reached based on previous chapters in chapter 6. In particular, how to define and understand the key term ETC are concluded with the characteristics. Also, some limitations are to be discussed therein. And the ending chapter 7 is the recommendation for further study in this topic.

LIST OF CONTENT

LIST OF CONTENT (CONT.)

LIST OF TABLES

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES (CONT.)

ABBREVIATIONS

ACMECS	=	Ayeyawaddy-Chao Phraya-Mekong Economic Cooperation Strategy
AEOs	=	Authorized Economic Operators
AFAFGIT	=	Association of Southeast Asia Nation Transport Agreement
ADB	=	Asia Development Bank
ADBI	=	Asia Development Bank Institute
AEC	=	ASEAN Economic Community
AIFTA	=	ASEAN-India Free Trade Agreement
AIIB	=	Asian Infrastructure Investment Bank
ASEAN	=	Association of Southeast Asia Nation
ASW	=	ASEAN single window
ATF	=	Agreement of Trade Facilitation
BCP	=	Border Crossing Points
BIMSTEC	=	Bangladesh, India, Myanmar, Sri Lanka, Thailand Economic Cooperation
BEZ	=	Border Economic Zones
CAFTA	=	China-ASEAN Free Trade Area
CBTA	=	Cross-border Transport Agreement
CER	=	Closer Economic Relations
CFR	=	Cost, Freight and Cost
CGE	=	Computable General Equilibrium
CNKI	=	China National Knowledge Infrastructure
DM	=	Decision Maker
DSS	=	Decision Support System
CTS	=	Customs Transit System
EC	=	Electronic Commerce
EEC	=	Eastern Economic Corridor
EIA	=	Environmental Impact Assessment
EIB	=	European Investment Bank

ABBREVIATIONS (CONT.)

ETC	=	Efficient Transportation Connectivity
EU	=	European Union
EZ	=	Economic Zones
EWEC	=	East–West Economic Corridor
FDI	=	Foreign Direct Investment
FOB	=	Free On Board
FLR	=	Fuzzy Linear Regression
GDP	=	Gross Domestic Product
GMS	=	Greater Mekong Sub-region
GRA	=	Grey Correlation
GVC	=	Global Value Chain
HIAP	=	High-income Asia and Pacific countries
ICT	=	Information and Communication Technology
IIT	=	Intra-industry trade
IMF	=	International Monetary Fund
IMT-GT	=	Indonesia-Malaysia-Thailand Growth Triangle
IT	=	Information Technology
JICA	=	Japan International Cooperation Agency
Lao PDR	=	Lao People's Democratic Republic
LCB	=	Laem Chabang Port
LLG	=	Lao Logistics Group
LPI	=	Logistics Performance Index
LSPs	=	Logistics Service Providers
MAD	=	Mean Absolute Deviation
MRE	=	Mean Relative Error
MMRE	=	Maximum Relative Error
MFN	=	Most Favored Nation
MSR	=	Maritime Silk Road
NAFTA	=	North American Free Trade Agreement

ABBREVIATIONS (CONT.)

NRI	=	Networked Readiness Index
NSEC	=	North-South Economic Corridor
NSWs	=	National Single Windows
NTBs	=	Non-trade Barriers
NTC	=	National Trade Corridor
PRC	=	People's Republic of China
POP	=	Population
PPP	=	Public Private Partnership
R3W	=	Route No. 3 West
RFT	=	Road Freight Transportation
RMB	=	Renminbi
SASEC	=	South Asia Subregional Economic Cooperation
SAFTA	=	South Asian Free Trade Area agreement
SD	=	Science Direct
SDR	=	Special Drawing Rights
SMEs	=	Small and Medium Enterprises
SREB	=	Silk Road Economic Belt
SSI	=	Single window inspection
STI	=	Single stop inspection
TTCs	=	Trade transaction costs
TEB	=	Traffic Economic Belt
VAT	=	Value Added Taxes
WB	=	World Bank
UNESCAP	=	United Nations Economic and Social Commission for Asia and the Pacific

ABBREVIATIONS (CONT.)

Cambodia   =   Kingdom of Cambodia

China, PRC   =   People's Republic of China

Lao PDR   =   Lao People's Democratic Republic

Thailand   =   Kingdom of Thailand

Vietnam   =   the Democratic Republic of Vietnam

Myanmar   =   the Union of Myanmar

CHAPTER I

INTRODUCTION

Background

The North-South Economic Corridor (NSEC), which has posed to be a flagship cross-national program of GMS (as defined in Footnote 1), has been witnessed the completion of physical/ hardware connectivity in the year of 2013 under the support of Asia Development Bank (ADB) in order to coordinate both hard and soft infrastructure. For such concern, the economic corridor model has been developed in GMS economic cooperation program with the key task of developing trans-boundary roads' access between the kernel economic centers and extending benefits of better connectivity to locations due to the geographic constrains in the GMS. It could be concluded that the primary target of cooperation relies on, based on the promoting physical connectivity among the member countries, improving the comprehensive and sustainable development of economies of members regardless of their diversities in geographic locations and political institutions.

Currently, nine corridors (as defined in Footnote 2) (Alignment is shown in Figure 1) have been recognized, with the NSEC (as defined in Footnote 3) and the East–West Economic Corridor (EWEC) as the most developed cruises in terms of demographic situation, traffic volume, connectivity, processing, markets and export nodes. The map shows that NSEC covers economic centers as Bangkok and Chiang Rai in Thailand, Jinghong and Kunming in Yunnan, People's Republic of China (PRC), among which large population reside in Bangkok, (8.3 million, 2013) and Kunming (3million, 2013) and/or largely rural and distant subsistence. In addition, the connectivity could be demonstrated by 15 airports along the route (5 are international airports), proximity to railroad (as defined in Footnote 4) and access to sea ports (as defined in Footnote 5). Further, large concentration of Economic Zones around Bangkok and Border Economic Zone (BEZ) at border crossings facilitate the import or export of materials or semi-manufactures processed at BEZ or EZ and industrial compositions like electronics, car and car parts, food and food products, chemicals and timber in Lao PDR part through exports nodes united by Kunming (airport), Boten and

Chiang Kong. Lao PDR (BEZ) and Bangkok (airport. port). Along with the assets along this corridor in aspects as forest resources. agriculture potential. plantations. mining and tourism potentials and energy sectors. economic diversification and close ties of history and culture. NSEC is expected to benefit members of economies to large potentials.

Objectives

The main rationale behind the study was that. along the GMS three original economic corridors. trade and interstate traffic has not grown as expected despite the efforts to improve road infrastructure. Most GMS member states do not fare well on the Logistics Performance Index (LPI) conducted by World Bank. There is a general perception that trade costs remain high and that trade opportunities are being missed. It has been well documented that trade growth and economic corridors performance were heavily dependent on the efficiency and effectiveness of the logistics sector. As the study illustrates. there could be a series of reasons why the logistics sector is not performing to its potential.

However. an enhancement of hardware infrastructure in NSEC has been progressed well. which is now a lesser constraint, there are so many impediments and constraints to challenge the efficient connectivity in aspects as logistics cost, border-crossing. human rescores institutional cooperation. information and political issues. As reported by the World Bank (WB, 2016). empirically. 75% of delays in trade are due to the managerial constrains like cargo inspection, customs declaration and tariff process and clearance. while only 25% are originated from the poor road conditions and port infrastructure. The lack and high cost of logistics due to not only in monetary terms but also time and reliability. are hindering the growth of trade in NSEC. In other words. improvements in hardware connectivity along corridors would not entail increased mobility of people. goods. services. and information across borders without supporting software connectivity involving in policies. rules or regulations regarding procedures. and systems. As mentioned in the National Development Plan 2012-2016 of Thailand. the effectiveness of the Cross-Border Transport Agreement (CBTA) has been impeded by the inefficiency in cross-border transport. Therefore. the infrastructure put in place along economic corridors. a physical time and cost consuming link with neighboring countries. has not been reasonably made use of. As a result. Thailand has been posed in

an unfavorable situation when competing with foreign companies, who are equipped with advantages in capital, technology, and specific expertise, especially in the logistics business. It could be concluded that NSEC's full potentials will not be realized until an efficient connectivity in both hardware and software infrastructure is achieved.

Due to the existing challenges to the efficient connectivity along NSEC, the positive effects, however, from both micro and macro perspectives have gone far away from what has been expected after time and cost-consuming investment of physical infrastructure, and adverse effects on environment and climate changes evolve to be burgeoning issues unexpected. For the most beneficiaries, Thailand, Yunnan Province and Lao PDR have to confront with a common and general challenge about how to realize the positive benefits to the most extend and mitigate the negative impacts to the minimum. In other words, based on the current infrastructure of NSEC, how to make the corridor seamless or efficient in transportation connectivity, hard and soft, is the core consideration for each economy.

The existing studies, though in weak in some certain way, have proposed obstacles in financing, governmental cooperation, road improvement, rules and institutional frameworks, solutions to which are depend on government action first. Thus the further research is critically and urgently important to work out an innovative, acceptable, measureable and feasible approach for further integration in GMS and references for other communities at the rest of the world. Based on the above puzzles in either practice or theory, in order to work out solutions to this general concern, this research is designed to answer the following questions.

1. Logistics Performance along NSEC

Since any economic corridor is not just a connection in a physical manner, NSEC would be a highly efficient connectivity which allows the smooth movement of people, goods, related information and services along the corridor. For this purpose, some questions could be categorized as: what is the status quo of logistics performance along NSEC; what are the main obstacles for efficient transportation connectivity in operation and how much percentage or weight are these obstacles; what key determinants of efficient transportation connectivity are and which key determinants are essentially critical for NSEC in particular. The main obstacles from the existing researches lie with sustainable financing, benefit distribution among three members and

carrying-out of CBTA. Statistical data and the relative analysis are needed to support the conclusion for the sake of the objectiveness.

In light of this concern, the concept of efficient transportation connectivity should be defined, and then follows with what the dimensions are and what does constitute each dimension as well the weight of each. Thus the correlation of each determinant is to be illustrated.

2. Potentials of NSEC

Before studying this corridor, it is necessary to estimate that the corridor would entail movement of people and goods along any node. In other words, the current physical connectivity should be certified that there remains space to be explored for further movements of cargo and passengers. The existing researches, however, from the perspectives of impact analysis in both positive and negative way, do not discuss how many cargoes or passengers could be expected after completion of this NSEC, or what is the difference between the real existing volume of cargo or passengers and the expected ones. And from the chronological aspects, what is the possible volume in the next ten or twenty years could reflect the importance of this corridor for three members along this corridor. For the cargo volume, in particular, the competitiveness and complementarities between Thailand and Yunnan province, PRC are to be discussed. Thus this thesis must take the potentials of NSEC as one of the priorities to study. Thus, this question could be explained for answering the innovation or originality of the research.

3. Determinants of ETC

With the statistical data about the potentials and obstacles along NSEC, measures of overcoming these challenges are to be proposed. All existing studies with solutions take the governmental cooperation as the first step to take, so how can the solutions in this thesis tackle with the embarrassing situation and how to make these solutions feasible is the focus to be worked out. In other way, what are the main solutions, innovative and feasible, target for each aspect of main obstacles or challenges and how the idea is innovative, acceptable, measureable and feasible would be also the originality of the thesis?

Further, how to implement the solution in stages of preparing, trying, measuring, governing, adjusting, re-constructing and evaluating is to be addressed also. For this purpose, what lessons or experiences could be learnt and what kind of experience could be referred for other communities with lower integration degree could help clarify the general suggestions. In addition, rather than pinning on the development of members of NSEC and GMS, how this corridor can be developed into an economic corridor in real sense and serve for the global supply chain and value chain would be explored for longer future years.

Based on the previous statement, the key target is to find determinants of efficient transportation connectivity, which would base on the parameters to define the coefficient of the ETC and to realize the real sense of ETC from both the qualitative and quantitative approaches.

Therefore, the three targets in this thesis are to satisfy the originality, objectiveness, comprehensiveness, innovation, and feasibility of this topic and this thesis and make the general concern measurable and solvable from the new approach with regard to the efficient connectivity between Thailand and Yunnan along NSEC of GMS.

Importance

The NSEC can be considered as one of the backbones of GMS trade because it connects to all other GMS Economic corridors as well some important trade routes such as NR 13 in Lao PDR that serves bilateral PRC-Lao PDR trade. And the main routes connect Kunming, capital city of Yunnan province, PRC and Bangkok, capital of Thailand. With the up-growing trend of international trade between Yunnan and Thailand, traffic volumes along the NSEC vary significantly and the large majority of international trade is between Thailand and PRC (through Lao PDR).

NSEC is critically important for both Thailand and Yunnan due to its need of economic development from the perspectives of connectivity. From the perspective of Thailand, shocked by the financial crisis in Southeast Asia in 1997 and 1998, the 2008–2009 world financial crisis, major floods in 2011 and frustrated by heavy public deficit (approximately 43.5% of GDP in 2012), Thailand has to be keeping on progressing, and a new path of greater connectivity to the regional economies is one of the ways out. For

the domestic economy, in order to overcome the shortage of operational workers and the comparatively higher salary. Thailand has changed its economic structure pattern by increasing the outward FDI in labor and resource intensive industries, which requires connectivity with regional economies. And for the open or external economy, Thailand therefore has been witnessed a changing trade structural toward to such emerging markets in ASEAN, PRC and India along with its traditional trading partners of Japan and EU, which have resulted in an increasing links with the regional and global supply chains. Thus from the concern of sustainable economic development, Thailand's strategies has responded to the outward FDI promotion, the creation of regional production networks through cooperative connectivity. Further, statistics shows that China has become the largest trading partner for Thailand since 2013, followed by consecutively 20 years' growth of bilateral trade. Therefore an efficient connectivity with smooth process with the least logistics cost along NSEC are critically important in linking Thailand and China by road.

At the same time, Yunnan's geographic location in China and in Southeast Asia makes the NSEC a great sense for its development of economy and China's national strategy. Located on the southwest border of the People's Republic of China (PRC), Yunnan Province is adjacent to the Lao PDR, Myanmar, and Viet Nam. The Yunnan Province section of the Shantou--Kunming component of National Highway 323 remains to be the most critical link of Yunnan Province with the east cities and coast of the PRC, where the economic progress are the most developed and a local passage from Yunnan Province to other parts in China. And the construction of NSEC has been deemed as the land route from Yunnan Province to Southeast Asia, a major external and potential market. Thus NSEC serves as the main land route for trade between the Yunnan Province and Thailand, and a key land link opening up sea access to China. It is also a direct trade conduit between southern People's Republic of China (PRC) and northern Viet Nam. Having China's only two borders with the countries of the Association of Southeast Asian Nations (ASEAN), NSEC is well positioned to serve as a gateway for framework of ASEAN+1 (PRC), which is expected to expand rapidly with the implementation of the free trade agreement (FTA) between China and ASEAN. NSEC's links also extend southward from Thailand to Malaysia, Singapore, and the rest of ASEAN. NSEC, with intersects the GMS EWEC in Thailand's Tak and Phitsanulok

provinces, provides access to the Andaman Sea and South China Sea. Thus the NSEC is the connection for Yunnan province and for the whole China with the economic and political significance strategically.

Scope

As discussed above, the methodology in this thesis will adopt both the quantitative and qualitative approaches, the former of which is the core tools to support conclusions of this research. Hypothesis is unavoidable for statistical analysis.

1. Traffic Volume

Many research studies have indicated a high correlation between improved logistics performance and increased trade. To some certain extent, the volume of bilateral trade between trading partners are determined by some factors such as the time and the costs over distance, the complexity of crossing the borders, and the customs and duties imposed. It is, however, hard to gather data on the true level of NSEC cross-border trade because a large and probably significant share—by its nature impossible to quantify—is informal, that is, trade that bypasses appropriate customs procedures. And the international logistics, taken from a supply chain perspective, refers to cost, time, and complexity in import and export operations and plays increasingly important part in satisfying the international trade with the integration of world economy and regional economy. Therefore, the underlying impetus along NSEC originates from the complementarities among the GMS members and particularly between Thailand and Yunnan. So it is assumed that the traffic volume along NSEC originates totally from the trade between Thailand and Yunnan, with the point of origin at Bangkok (or Kunming) and the point of destination at Kunming (or Bangkok).

2. Kunming-Bangkok Sub-corridor

As mentioned above, NSEC consists of three major routes along the north–south axis of the GMS (see GMS map highlighting these routes in Figure 1) that connect major population and economic centers in the northern and central parts of the sub-region.
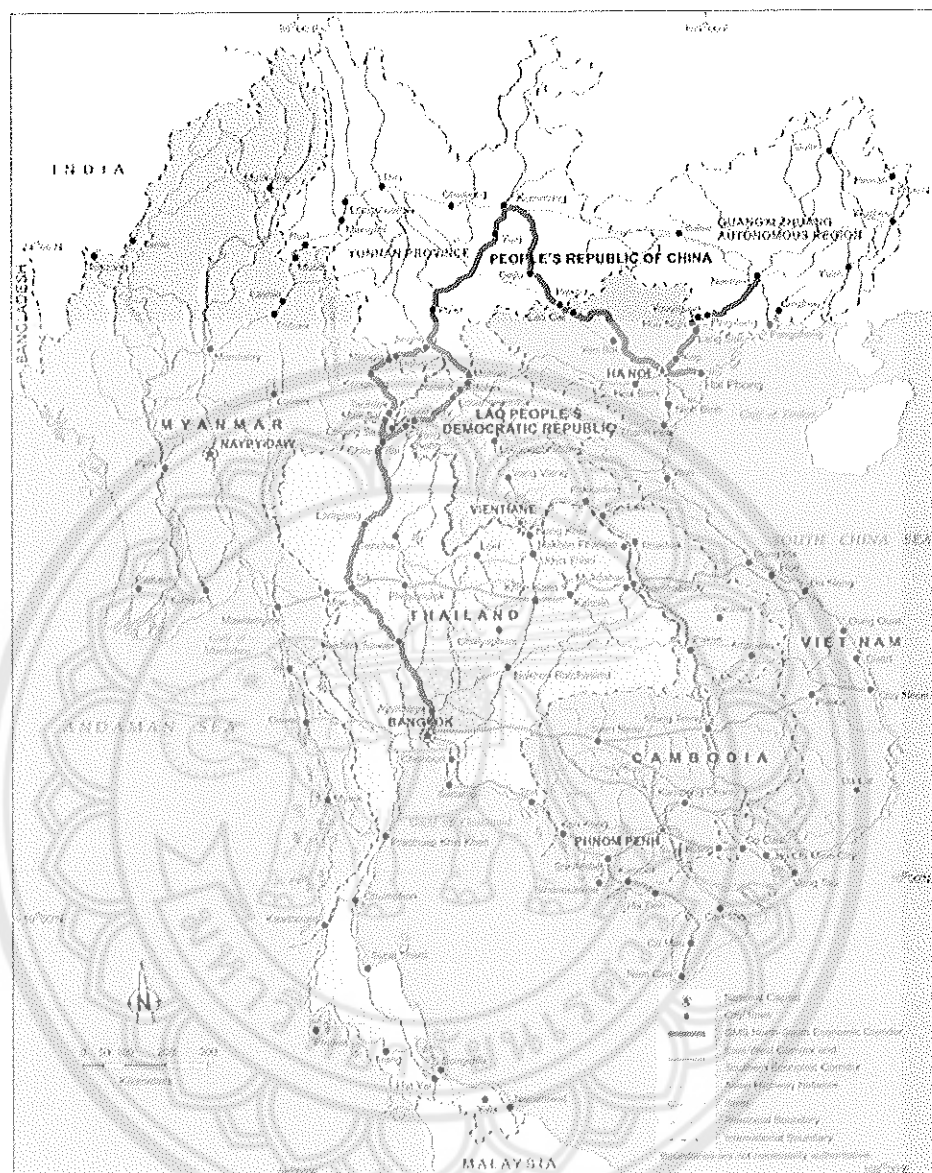
Figure 1 Routes of NSEC

Source: ADB, 2008

In this paper, only one route Bangkok-Kunming via the Lao PD in Western Sub-corridor is studied (See below Figure 2). The target route stretches as Kunming (Yunnan Province in PRC-Yuxi (Yunnan Province, PRC-Xishuangbanna (Yunnan Province, PRC-Jinghong (Yunnan Province in PRC-Mohan (Yunnan Province in PRC-

Moton (Louang Namtha province in Lao PDR)-Houaxay (Bokeo province in Lao PDR)-
Chiang Khong(in Thailand)- Chiang Mai (in Thailand)-Lampang (in Thailand)- Tak
(in Thailand) -Kamphaeng Phet (in Thailand)-Nakhon Suwan (in Thailand)-Ayutthaya
(in Thailand)- Bangkok (in Thailand). And the other one runs as Kunming (Yunnan
Province in PRC–Yuxi (Yunnan Province in PRC-Xishuangbanna (Yunnan Province in
PRC-Jinghong (Yunnan Province in PRC-Mohan (Yunnan Province in PRC-Moton
(Louang Namtha province in Lao PDR)-Houaxay (Bokeo province in Lao PDR)-
Chiang Khong (Thailand)-Phayao (Thailand)- Phrae (Thailand)- Uttaradit (Thailand) –
Phitsanulok (Thailand)–Nakhon Suwan (Thailand)- Ayutthaya(Thailand)- Bangkok
(Thailand). In light of quantitative analysis, the whole route will be divided into three
sections as those in Yunnan, PRC, Lao and Thailand (See below Figure 2).
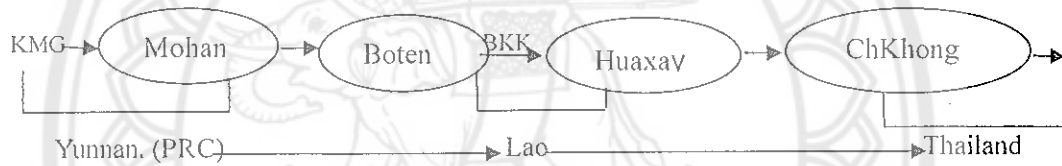
Figure 2 Three Sections of NSEC

Notes: KMG=Kunming   BKK=Bangkok   ChKhong= Chiang Khong
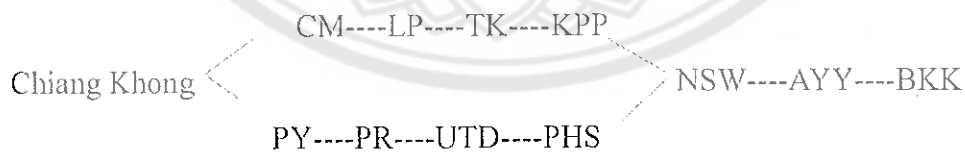
Notes: CM=Chiang Mai, LP=Lampang, TK=Tak, KPP= Kamphaeng Phet,
       NSW= Nakhon Suwan, AYY= Ayutthaya, BKK=Bangkok. PY= Phayao.
       UTD= Uttaradit, PHS= Phitsanulok

Figure 3 Two Lines from Chiang Khong to Bangkok
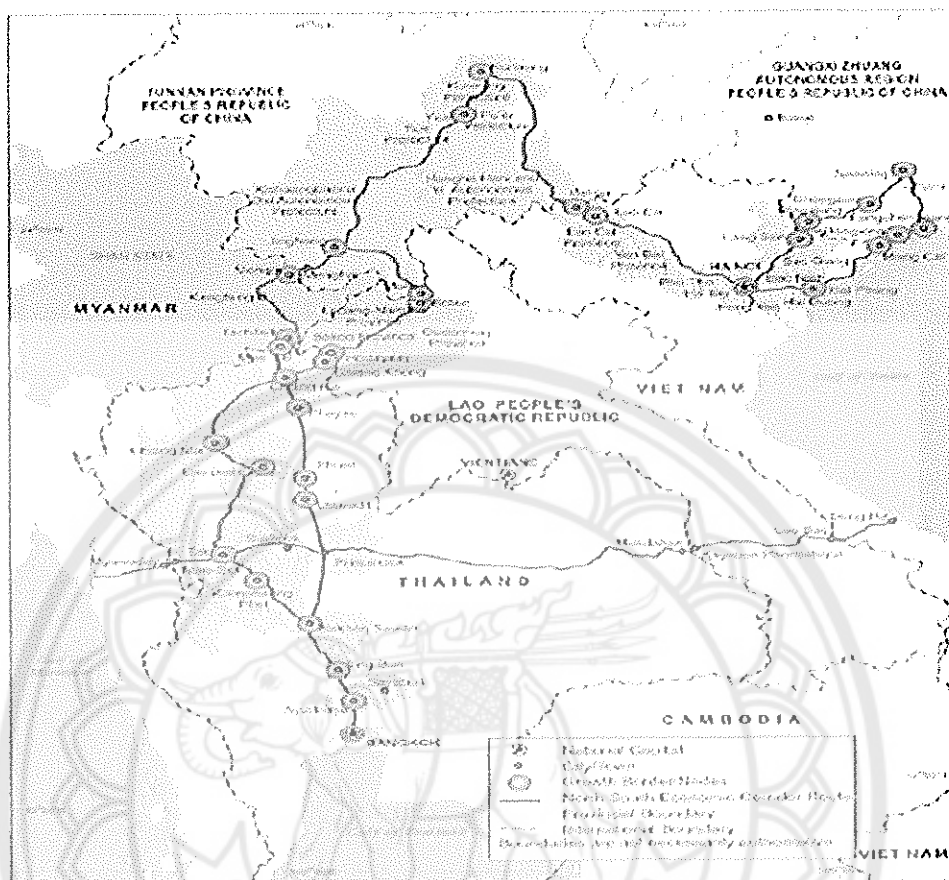
Figure 4 Key NSEC Provinces/Areas and/or Border Nodes

Source: ADB, 2014

Research Terms

      Analyzed from the title of this thesis, we can conclude that the five key terms lie with GMS, NSEC, efficient transportation connectivity, Thailand and Yunnan, among which, NSEC or economic corridors and efficient transportation connectivity are the keys to understand the focus of this thesis. Reviews in this thesis are mainly to be developed from such three key aspects as NSEC or economic corridors and efficient transportation connectivity as well as logistics performance as the priorities and then other three terms are presented in one separate set. For the full understanding of the three terminologies, definitions about economic corridors and connectivity are to be discussed first.

1. Economic Corridor

The concept of economic corridor means a holistic strategy, aiming to develop a highly efficient transport system, which facilitate goods and people move without excessive cost or delay as well as the development of production networks. Economic corridors and connectivity are inextricably bound with each other. Economic corridors evolve from the transport corridors, sets of routes connecting the economic centers within and across major economies. Thus economic corridors are such transport corridors surrounded by industrial economic clusters with linking to global production networks and facilitating industrial economic clusters. The economic corridor (as defined in Footnote 6) focuses on the integration of infrastructure improvement with opportunities in trade and investment, efforts to address outcomes of increased connectivity (Prabir De, 2014).

2. Connectivity

Connectivity, broadly defined (ADB, 2013), covers both physical connectivity and associated institutional connectivity, the former of which refers to physical infrastructure (as defined in Footnote 7) related to transport and energy and the latter is the critical areas to make the hardware work efficiently. Thus economic corridors can be defined as a blueprint for enhanced connectivity and increased competitiveness for a better integrated community.

From another way, infrastructure can be categorized into hardware infrastructure and software infrastructure. The former refers to physical facilities in transport, energy, telecommunications and basic utilities, which support the development and progress in society and economy. The latter could be found in non-tangible mechanism supporting the development and operation of hardware or physical infrastructure in the forms of institutional frameworks; governance; systems and operational procedures; and sets of transparency and accountability of financing and procurement systems (Bhattacharyay, 2008).

3. Logistics Performance

The logistics performance, as defined in Logistics Performance Index (LPI) by World Bank, is a combination of in-depth knowledge of the countries where they operate with informed perceptions of other countries with which they trade, and experience of the logistics environment. There are six components in PLI, namely,

customs, infrastructure, ease of arranging shipments, quality of logistics service, tracking and tracing, and timeliness.

4. Border-crossing

Since NSEC is a cross-national or regional passage for Thailand, Lao or Myanmar and Yunnan province, PRC, and the border-crossing is an unavoidable section, thus the defining of cross-border becomes a necessity. Cross-border infrastructure may be defined as infrastructure that connects two or more economies, or has significant cross-border impact. Therefore, a large portion of national logistics nodes, for instance, airports, ports, roads, and railways, can be deemed as cross-border facilities.

5. ETC

Based on the definition of connectivity, the efficient transport connectivity is defined to cover two aspects. From the hardware perspective, it refers to the necessary physical infrastructure in a sustainable way and form the software way, it relates to government cooperation (such as CBTA); skilled operation with least stops (non-value added), incentives for more transportation, sustainable financial supports and least time and risk in mutual trade. Thus, ETC means Operate and inspire the transportation smoothly with the least or no waste of time, cost, energy and source for all participants, including the shippers, consignees, carriers (logistics companies and freight forwarders), customs' brokers and officials and so on.

Conceptual Framework

Based on objectives mentioned in 1.2, the rest chapters are organized as the following (See as Figure 5 shows). Chapter 2 is a systematical literature reviews for getting out the originality of the study in both theory and practice from the perspectives of connectivity in hardware infrastructure and software infrastructure as well as the logistics performance along NSEC. Followed chapter 3 discusses the methodologies from both quantitative approaches, including introduction of the methodology, data required and selected, variables selection, model's set-up and testing, and qualitative perspectives, the former of which aims to make a cargo volume predication and an assessment of logistics performance along NSEC. Thus in chapter 4, the data are to be input and results are presented through the model of time-cost model and fuzzy linear regression respectively, from which constraints are analyzed and potentials

of NSEC is concluded and challenges in impediments and accordingly in chapter 5 and proposed also are suggestions for how to make the NSEC become an efficient connectivity and how to facilitate the logistics performance between Thailand and Yunnan. Thus the conclusions are to be reached based on previous chapters and limitations of this research are also given in chapter 6. The last chapter 7 proposes some research recommendations for future studies.
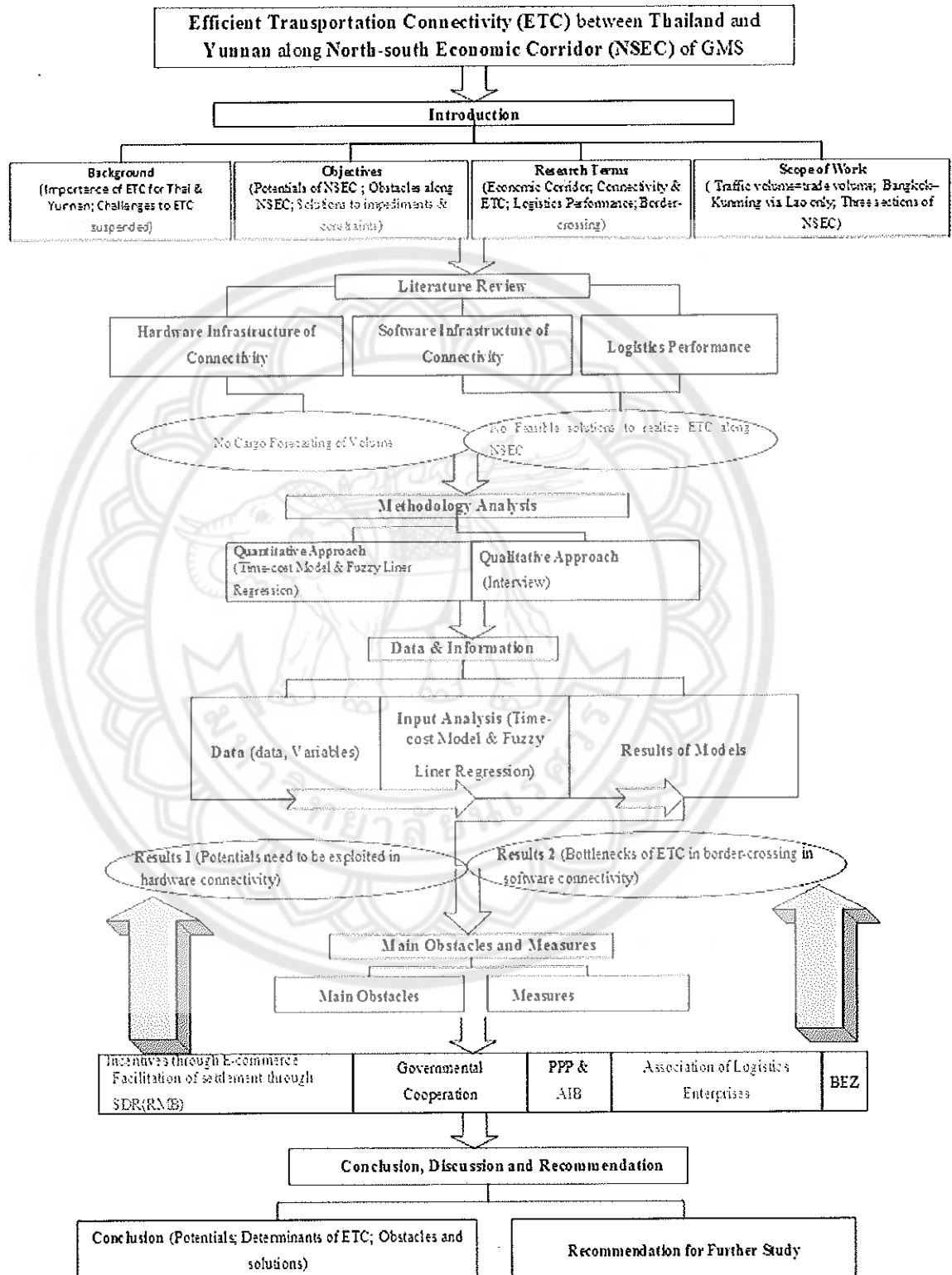
Figure 5 Research Flowchart
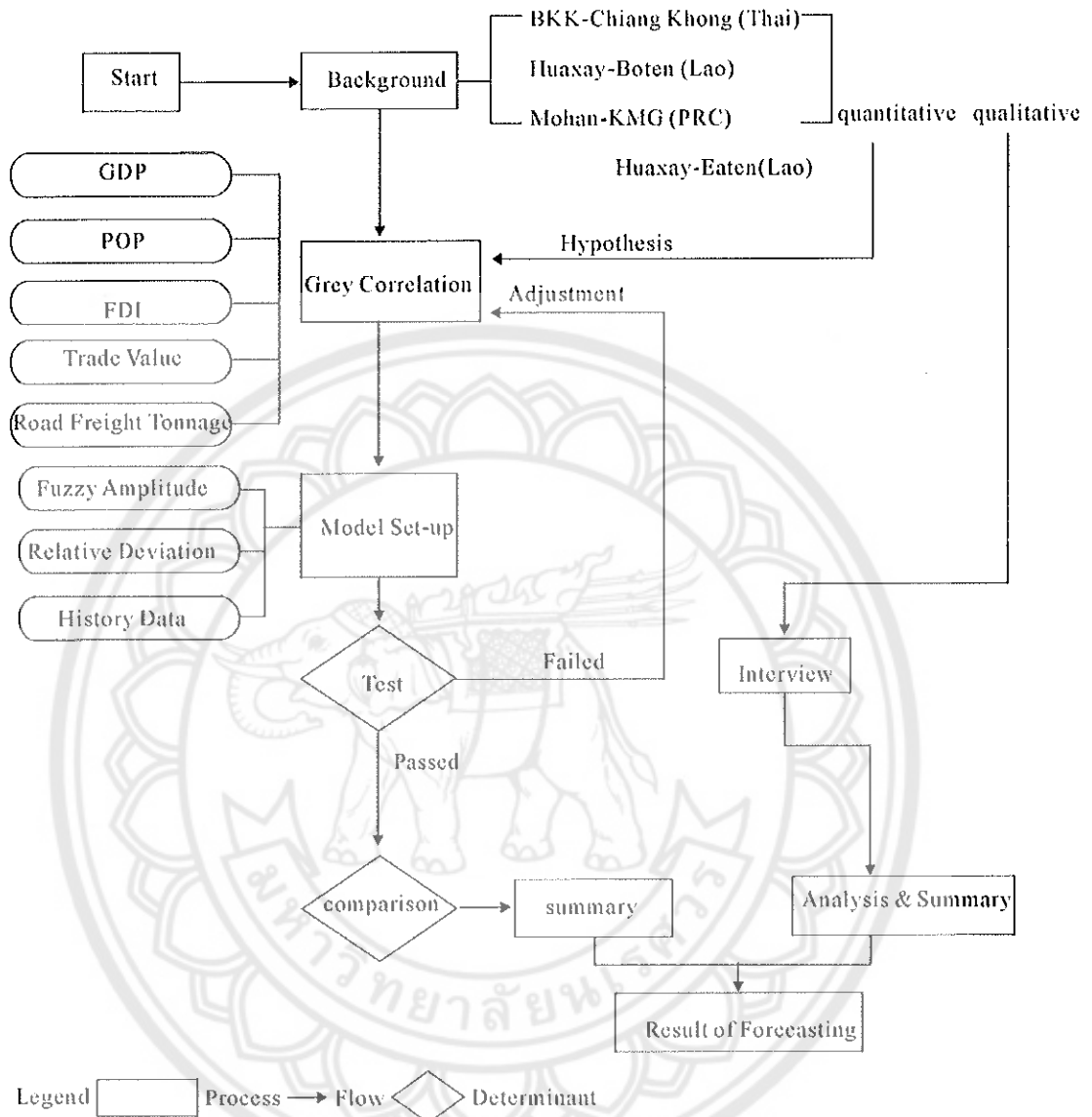
Figure 6 Research Flowchart of Methodology

CHAPTER II

LITERATURE REVIEW

Based on the introduction in chapter 1, in order to work out the obstacles and potentials along NSEC, the potentials of this corridor and accordingly propose solutions feasible, a systematical review of literatures is required. Thus this part of the thesis aims to answer the following questions: 1) what have been studied as the focus in each field of five key terms and which methodologies or approaches are prevalently adopted? 2) To what extend do these researches be limited? 3) What are the main constrains or challenges or weak logistics performance for the development of NSEC? And 4) what could be the originality for this thesis and future studies?

The literature review analyzed in this thesis is based on articles, publications and thesis and dissertations from CNKI (China National Knowledge Infrastructure), SD (Sciencedirect), Googlescholar, and ADB (Asia Development Bank) within the 1994–2016 periods. Key words such as "economic corridors", "NSEC", "connectivity", "infrastructure", "GMS", "logistics performance", "Cross-border", "Thailand and Yunnan" and "BEZ" are employed to cover the full text of the thesis.

The review is to be taken from both bibliometric and chronological perspectives, the former of which is to find out the trend and focus of researches in general concern and the latter of which is to get specific ideas what have been studies or kept virgin. The combination of the two approaches could help answer what this part aims at to a comprehensive degree.

Bibliometric Review

Systematic literature reviews are completed through an iterative process of defining appropriate search key words, searching the literature and completing the analysis (Saunders et al., 2009).

1. Methodology and Initial Statistics

A four-step methodology for data collection and comprehensive evaluation is adopted to sort out the most influential studies, determine the current researches' focus and interests, work out the insights of the current researches and propose the future

directions of studies.

       1.1 Defining the appropriate key terms. In order to cover a broad range of research result. three levels of key words assembly are designed in Table1. As the table shows. the key and first layer is NSEC, the core term as the title shows, and the second and the third levels are the "software infrastructure" and "hardware infrastructure" (Banomyong. 2007) respectively.

Table 1 Proposed Three Levels of Key Terms Assembly Structure

Core term: NSEC
"Software infrastructure" Key Words: Institutions' Cooperation and Trade Reform. Institutional Risks to Connectivity. Financial Infrastructure. Logistics Performance. Regional Economic Integration(in GMS. in ASEAN and CAFTA. in East Asia and Southeast Asia. and in Asia and Global Production Networks). Sino-Thai Trade(general trade and trade of particular commodity), Regional Cross-border Logistics Network. connectivity and Border Economic Zone (BEZ).
"Hardware infrastructure" Key Words: Financial Demand Estimation. Impact Analysis. Cost & Benefit Analysis, Trans-Asia Railway and transport corridor.

       1.2 Initial data result. Using the "title", "key words" and "abstract" in the CNKI, SD, Google scholar and official web of ADB, we identify 146 papers in total. In order to concentrate on key terms of above layers, 22 papers are deducted and thus, a total of 124 articles are analyzed (see Table 2). In particular, integration and transport infrastructure are the main focus in this field. 45 papers (approximately 34%) are published with the focus to the former and 21 papers (approximately 16%) study the latter. Followed concern relies on transport corridor (18 papers) and connectivity (16 papers). And there are 15 papers are related to logistics and trade but only 1 paper directly discusses the logistics performance along NSEC. Along with the cargo forecasting and BEZ (2 papers respectively), the three subjects are weak in research findings or insufficient in mastering capability and may constitute suggestions for future study.

Table 2 Statistics of Main Subject Areas

Subject Area	No. of papers
Border Economic Zone	2
Cross-border	11
Connectivity	16
Forecasting of cargo	2
Integration	45
Logistics outward of Thailand	2
Logistics outward of Yunnan	3
Logistics performance of NSEC	1
Sino-Thai logistics and trade	9
Thailand-Yunnan logistics and trade	1
Transport corridor	18
Transport infrastructure	21
Total: 12 subjects of 131 papers	

1.3 Initial data statistics. Graph 1 shows the publishing trend in the field by plotting the quantity of publications from the years 2006 to January 2016. A fluctuating growth in the number of publications can be observed especially after 2008. The downward trend in the interval year 2011/2013 is made up immediately by significantly rise in the numbers of publications in the interval year 2010/2012. 2014 witnesses the sharp climbing-up of numbers of papers to the peak at 59. Afterwards, a decrease could be shown in 2015 by approximately 73%, compared with the summit in previous one year. And it could be predicted that there will be a growing-up trend in 2016 since in the first one month 8 papers are available on line for reference.
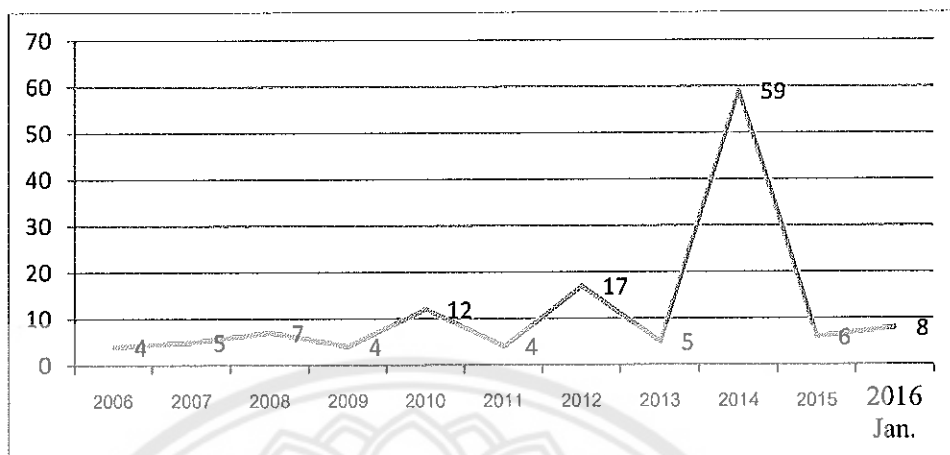
Figure 7 Publishing Trend in 2004-Jan. 2016

1.4 Data analysis. Data analysis is conducted in bibliometric analysis, which provides additional data statistics including key contributing authors, journals, universities and organizations as well as other sources of papers.

2. Bibliometric Analysis

Table 3 tells us the key authors with more than 2 papers published in the past ten years. In particular, all these three authors are from Asia Development Bank, the sponsor of the GMS.

Table 3 Key Contributing Authors

Author	No. Of Published Articles
Biswa Nath Bhattacharyay	3
Douglas H. Brooks	2
Manabu Fujimura	4

Figure 7 demonstrates the classification according to their research nature: empirical vs. theoretical. It could be concluded that the majority part of papers belong to the empirical nature and the minor part 7% (less than 10 papers) goes to the theoretical one, which are two theories, analysis of international logistics in terms of impacts on international trade and point-axial system theory.
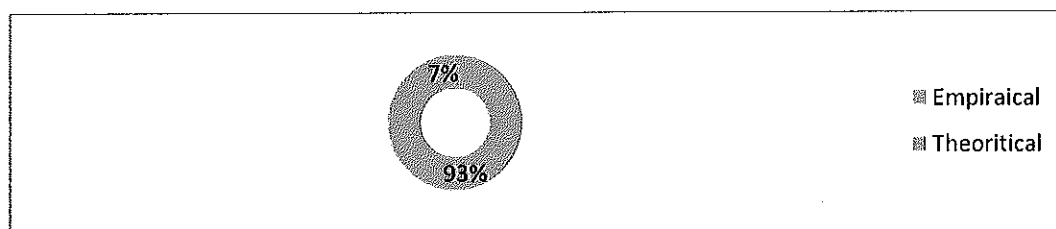
Figure 8 Research Nature Classification

In terms of the research methodology, Table 4 shows the classification from two aspects: quantitative and qualitative. Regression in the former and questionnaire and interview in the latter are the three most frequently adopted approaches in two kinds of ways respectively. And in general, the quantitative approaches constitute the main ways of research with the qualitative methods as the complimentary.

Table 4 Classification of Methodology

Quantitative	Frequency (times)	Qualitative	Frequency (times)
Granger	1	Interview	5
Regression	10	Field Research	3
Simulation	3	Questionnaire	5
Appadurai "s-scape" approach	1	Project Meeting	2
Snapshot	1	propensity score	2
top- down and bottom- up	1	Case d study	2
AHP	1	Survey	1
Heuristics	1		

Concerning the journals contributing to this area (in Table 5), Journal of Greater Mekong Subregion published the 3 papers in 2008, but in the following years, no papers contributed. Another two journals- Transportation Research Part E and Transportation Research Procedia published 2 papers in the past one decade, among other 29 kinds of journals contributing papers in this field. This situation may reflect

that the academic capability in this field is to be enhanced in some aspects. From another perspective, some universities and organizations have conducted studies in other forms like thesis for master degree, dissertation for doctoral degree and working series papers and publications.

Table 5 Journals Contributing to Logistics Performance of NSEC

Journals	Publication year										
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016(Jan)
Applied Econimics									1		
Economics, Management, and Financial Markets									1		
European Economic Review	1										
Geopolitics							1				
Int. J. Production Economics							1				
International Journal of Production Research							1				
International Trade							1				
JGNUN							1				
Journal of Bangladesh Institute of Planners				1							
Journal of Chemical and Pharmaceutical Research									1		
Journal of Economic Perspectives		1									

Table 5 (cont.)

Journals	Publication year										
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016(Jan)
Journal of Greater Mekong Subregion			3								
Journal of Political Economy								1			
Journal of Southeast Asia Economies									1		
JGNUN							1				
Journal of Transport Geography							1				
Modern Logistics	1										
Production and Operations Management Society							1				
RTBM							1				
The World Economy							1				
The Southern Business and Economic Journal							1				
Scientific Journal of Logistics									1		
Social and Behavior Science									1		
Southeastern Asia		1									
System Engineering Procedia						1					
Transport and Engineering			1								
Transportation Research Part A									1		

Table 5 (cont.)

Journals	Publication year										
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016(Jan)
Transportation Research Part E									2		
Transportation Research Prodedia									2		

Table 6 Contributing Universities and Organizations

University	Publication year										
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016(Jan)
ADBI	1		1	1	5	1	2		9	2	8
ADB		1	1		1	1	3	2	38	4	
ADB & ADBI				1				1			
Cambridge University					1						
CUEB					1(M)						
Dalian Maritime University							1				
East China Normal University							1(M)				
Fudan University							1(M)				
Huaqiao University							1				
Hunan University, China		1(D)									
International Conference					1		1				
Jilin University									1(M)		
KUST		1(M)									
Levy Economics Institute					1						
Ningbo University					1(M)						
Southwest Jiaotong University					1(D)			1(D)			
Thailand Development Research Center			1								
University Of Southern Queensland				1							
WUT			1(M)								

Note: SCUT= South China University of Technology; CUEB=Capital University of Economics and Business. Chin; WUT= Wuhan University of Technology; KUST= Kunming University of Science and Technology; M=thesis for Master Degree; D=dissertation for Doctoral Degree

The statistics (Table 6) shows clearly that ADB and ADBI are the main contributors, whose researches constitute nearly 62% of all literatures, but the cooperation between ADB and ADBI is minor, only 2 literatures. In addition, 13 universities with 9 in China undertake related researches, but all these researches are taken by graduate students for the sake of applying for Master Degree (8 thesis) or Doctoral Degree (3 dissertations), which can demonstrate that the research is weak and sparse.

Chronological Review

Literature reviews considering all these terms from a broader standpoint have already been published separately or respectively, they keep on, however, discussing obstacles, constraints or challenges and pinning their hope on governmental cooperation as the first step on the one hand, and ignore potentials of this specific NSEC potentials on the other. In addition, "efficient transportation connectivity" is new terminology in this field of study.

Given the nature the key terms of this thesis, the author adopts an inductive approach for chronological progression of research. Based on the previous definition of key terms, the chronological analysis is to be developed from two perspectives: connectivity and logistics performance. Their analysis helps to understand the status quo of the subject in research and pave the way for the originality and the significance of this thesis. The review is to be developed in such sequence as infrastructure connectivity and logistics performance along NSEC. Thus, combined with the above definition, the chronological analysis is to analyze review of hardware transport infrastructure, software infrastructure of connectivity and logistics performance along NSEC.

1. "Hardware" Transport Infrastructures of Connectivity

As defined above, hardware infrastructure refers to physical structures or facilities such as transport, energy, telecommunications and basic utilities. In order to

concentrate on the key term of efficient transport connectivity, the review of this part only relates to the transport only.

1.1 Financial Demand Estimation

Many researches have involved in estimates of Asia's infrastructure needs, with GMS as one of the sub-regional focuses included. Indicative investment needs for GMS is estimated to be U.S. $ 47,302 million in total 50 projects, in which U.S. $ 5,858 million goes for 17 transport projects. In particular, 5 high priority projects are related with transport infrastructure, which are expected to strengthen regional infrastructure connectivity through creating positive precedents and the way for progress on a much larger number of regional projects.

The estimates of total national infrastructure needs by Biswa Nath Bhattacharyay (2010) for 2010–2020 increased by US$230.8 billion. The author predicts, for the first time, the financing needs for regional infrastructure projects to almost US$8.22 trillion (in 2008 US$) for infrastructure investment during 2010–2020 (approximately 35 percent goes for transport), about 6.5 percent of Asian estimated 2010–2020 GDP. Also, the paper estimates the financial need of GMS in total and in individual member. For transport infrastructure, the total estimated US$ 5,858 million are shared US$ 200 million for airport or port, US$ 1,523 million for rail, US$ 3,972 million for road and US$ 163 million for TF or logistics.

Chiranjib Neogi (2014) indicates that investments in transport, energy, telecommunications, and tourism in the same geographic space, which are the priority infrastructure sectors, will maximize development impact and minimize development costs. Ghulam Samad and Vaqar Ahmed (2014) indicates that Pakistan's financial need for improving the country's highways, railways for additional tracks, and t for improving ports, airports, and other facilities. Hector Florento and Maria Isabela Corpuz (2014) suggest further study for the financial amount and sources after discussing the road and railway links in Myanmar, where pave the passages to northeast India and the rest of Southeast. Jean-Francois Gautrin (2014) explores strengthening connectivity and the role of cross-border transport infrastructure investments and the construction of a multimodal corridor linking Bangalore and Chennai to Dawei, Laem Chabang, and Saigon Port. Prabir De (2014) observes that due to expanded export and segmented production networks, there are increasing demandor physical connectivity.

ADB (2015) presents a summary about the investment costs ($73.1 billion) related with cross-regional connectivity projects in highways. railroads ($33.7 billion). ports ($11.1 billion). and energy trading ($10.5 billion) in south Asia and south-east Asia. Total investment costs are estimated at $73.1 billion.

1.2 Impact Analysis

Banomyong (2007), assuming full implementation of the CBTA, constructed a model to estimate cost reductions across all three routes for the Bangkok–Kunming corridor along NSEC are substantial. The model highlights delays at borders and other inspection points in time and cost components.

Edmonds, & Fujimura (2008) find a positive the impact of road infrastructure on trade and foreign direct investment (FDI) flows in the GMS. Manabu Fujimura (2008), from the aspect of the economic geography, emphasize the impact of cross-border transport infrastructure on trade. Although regional trade is driven by the size of economies, the increase of road density in GMS border regions by 1% could inspire the trade increase by 0.6%–1.4%. Thus recommendation has been made in encouraging regional integration through coordination of cross-border and domestic road infrastructure in GMS countries.

Anna Strutt, Susan Stone, & Peter Minor (2008) study the highest value of time for exports of vegetables and fruit from Thailand to other GMS members could be reduced in time by 25% to 26% under trade facilitation.

Fan Zhai (2010), based on the financing infrastructure investment during 2010–2020 estimated by ADB (2009), studies the welfare effects of developing regional infrastructure in Asia in increasing market access by lowering trade costs, which are 14.0 and 12.1 in China and Thailand in 2020 resulting from transport infrastructure investment in 2010–2020. Also, real income could be 4.7% of baseline GDP in China and 16.2 % in Thailand in 2020 due to the input in regional transport infrastructure in 2020.

Susan Stone, Anna Strutt, & Thomas Hertel (2010) estimate the positive impact of improvements (US$7915 million) in road transport infrastructure and trade facilitation in the GMS. In particular, Lao PDR could witness the changes in real DGP based on the data of 2004. And reduction of costs between the PRC and other GMS countries is critical for this estimation, especially in the intra- GMS exports. Another

concern is about the enhanced transport networks.

Manabu Fujimura, & Ramesh Adhikari (2010) evaluate the cross-border infrastructure projects in quality at entry, implementation and impact in macro- and micro-level. They point out that such measurable evaluating of cross-border benefits should be conducted at the beginning of the preparation stage and keep monitor in all the following cycles. Also, transit trade should be considered in construction of corridors and negative impacts of cross-border transport projects need to be predicated then.

John Gilbert, & Nilanjan Banik (2010) indicate the impacts of regional transport infrastructure from socio-economic perspectives, which are influenced by the initial GDP in South Asia. They list the biggest beneficiaries are India, Nepal and Bangladesh successively and other countries are possibly to be affected only marginally.

For the sake of proposing mitigation measure to help to reduce the negative environmental impacts and challenges relative to national projects to the least, ZhongXiang Zhang (2010) suggests that serious investigating with care alternatives of the regional infrastructure projects when they are to be designed and adopting the corresponding adjustment are the measures to the purposes.

Luisa Alamá-Sabater et al. (2011) shows the benefit of Spain in increasing imports due to its neighbors transport connectivity and thus implies for policy makers that an extensive, efficient and effective network must be constructed in different function according to the role in the network, in which logistics platforms play a fundamental role.

Manabu Fujimura, & Ramesh Adhikari (2012) focus on the importance of comprehensive assessment of economic and social impacts, livelihood restoration, monitoring mechanism, sufficient funds, improved capability and distribution analysis in the estimation of adverse impact of infrastructure projects, although the positive influence may run beyond national boundaries.

Peter J. Rimmer, & Howard Dick (2010) addresses the Asia's competitiveness in the world could be enhanced though links between main urban gateways, where the movement of people and freight can be quicker and smoother. SEZs (Special Ecnomic Zones) are suggested in compliance with the national infrastructure development in host countries for the purpose of mitigating the impeding such movements.

Hans-Peter Brunner (2013) indicate that productivity and export diversification could be realized through greater connectivity and regional integration by SMEs (Small and Medium Size Enterprises). However, further inland in areas in the GMS (Transport) Corridors may constrain the sub-region from integration into the Asian value chain networks.

ADB (2014) collects primary household-level data and literatures to certify that delays in implementing the CBTA in road corridors should contribute to the slight or limit impact under regional cooperation in members of GMS, with the exception of Lao PDR.

Chiranjib Neogi (2014) analyzes agglomeration of industries in India has been impacted by land infrastructure in terms of transport cost and time on regional trade.

Guanghua Wan, & Xun Zhang (ADB, 2014) find that in the PRC (1989–2011) telephone, tap water and electricity could have distributive impacts in social economic indicators, such as promoting rural income growth, accessing to better education or more experience and helping narrow the rural–urban gap.

Hector Florento, & Maria Isabela Corpuz (2014) suggest that strengthened connectivity in Myanmar under regional cooperation should consider the ways to mitigate both economic and non-economic negative externalities and coordinate with national plans, after examining the road and railway connections.

Myo Thant, & Hector O. Florento (2014, ADB) propose that much more focus should be put on the soft infrastructure in institutional structures and mechanisms, awareness of human resource, political commitments, and resources at national and regional perspectives in order to the equitably distributed benefits for members in the GMS and ASEAN.

Ghulam Samad, & Vaqar Ahmed (2014) study three road corridors in Pakistan and present for Pakistan's developing a NTC, where FDI could go to transport and communication sectors, trade zones should along be set up along motorways to inspire exports and therefore lower the cost of doing business through enhancing the transport connections of major ports in the south and south-west to industrial centers and neighboring countries.

Paramjit. S. S., & Vijay. L. (2014) investigate the strategic position of the Wagah–Attari land route (Amritsar in India with Lahore in Pakistan), along which the export of fresh vegetables and other agricultural products to Pakistan and imports of cargo from Afghanistan to India have been undertaken.

ADB (2015) assesses positive and immediate impact on economic growth, social bonding from increased volume of passengers due to the improvements of cross-border road's connectivity in GMS. Also, ADB (2015) indicate that 15% reduction in trade costs, from the overall economy, has been certified in South Asian and Southeast Asian trade, in which South Asia gains more, estimated at the amount of $375 billion or 8.9% of GDP in 2030.

1.3 Cost & Benefit Analysis

Hector Florento, & Maria Isabela Corpuz (2014) emphase the costs and benefits in cross-border infrastructure projects after examining the road and railway links in Myanmar, which pave the way for regional integration in trade liberalization, trade facilitation and infrastructure, and national transport infrastructure.

Myo, Thant, & Hector. O. Florento (2014) conclude that Lao PDR. due to the North-South Highway and Rail Link, has benefited from the NSEC, although with little practical impact.

1.4 Trans-Asia Railway

Thapana Bunyapravitra (2012) proposes more specifically that the use and development of railway spider network would be the most sustainable way in traveling between Thailand and China in the future. He believes that the logistic system among countries in this region after becoming a union would be developed to a more advanced railway network with high-speed trains travelling across borders as seen in Europe. This type of transport will promote common wealth of all nations by; decreasing travelling time, creating employment and income distribution, increasing limit of freight per round, diminishing fuel consumption (oil and gas), and serving international operation as Olympic Games or summits.

Pan Yunshi (2012) indicates that the Trans-Asia Railway could be a new alternative for transport in the future, especially for transport of oil, in terms of lowering the risks and narrowing down the distance by half. Also, the Railway could connect China with ASEAN and APEC countries, the one of the largest market for China.

The author studies the impact of Trans-Asian Railway Network to the Chinese international logistics from the perspectives of the China's status quo of international logistics, the status quo of western and southern border trade logistics, the influence of time, risk and cost on the import and export goods. Compared with other modes of transport connecting China with other ASEAN members, the transport capacity (3000-5000 tons/ track) and cost of time (100km/hour) by railway is superior than that of by waterway and road; in particular, transport volume via Mekong River is just 200.000-300.000 tons annually. At Kunming, the Trans-Asia Railway could connect with main railways in West China, like Cheng-kun, Qingzang and Lan-Xin railways so that West China could access to South-Asia and ASEAN countries more easily. But, the complete operation of railway encounters some barriers as budget deficit in Lao, consistency in cooperation among member countries, diversified standard track gauge (1676mm, 1435mm, 1067mm and 1000mm) and antagonism from Japan and India.

Sun Qun, & Lijia (2014) point out that the strategically importance of the railway also can be witnessed in other two ways: The Trans-Asia Railway could solve the constraint of oil transport for China via Malacca Strait, restrict by Malaysia, Singapore and Indonesia. This is deemed as the strategic target of Chinese government; The Trans-Asia Railway could make China access to Indochina and the South Asia subcontinent and direct to Europe, which make China less dependent on Malacca Strait.

Lijia (2014) studies the competitiveness comparison between railway and road from Kunming to Bangkok by separating into three segments. For mileage, the whole railway reaches to 1602, while the Kunming-Bangkok Expressway is 1887; with regard to transport time, the whole time is 11.4 hours by railway and 32.9 hours by Kunming-Bangkok Expressway; and in terms of cost, the railway freight per ton is RMB 527.7 and the charge by road is RMB 1011.5. Thus the superiority of railway for logistics is obvious.

2. Software Transport Infrastructure of Connectivity

Software connectivity includes the critical areas of institutions for coordination, trade and investment reforms, financing of infrastructure, and trade facilitation or integration, which aim to create physical infrastructure sustainably effective and efficient. And the reviews concerning trade facilitation is classified into the next part--logistics performance.

2.1 Institutions' Cooperation and Trade Reform

Biswa Nath Bhattacharyay (2009) indicates that ADB and WB remain to be multilateral in financing and sustaining infrastructure in ASEAN by providing money, knowledge and capability as well as honest broker.

M. Rahmatullah (2009), for Bangladesh to be a transport hub, studies issues related to regional connectivity and transit should be resolved jointly with the political will, an open mind and commitment of the leaders of South Asia so that the benefits of regional integration and connectivity could be expected.

Manabu Fujimura, & Ramesh Adhikari (2010) propose, under the political tension, the necessary regulatory aspects of regional trade and the cooperation in preparing regional infrastructure projects through ADB, an 'honest mediator'.

ZhongXiang Zhang (2010) studies the reasons why the constrain of regional infrastructure projects occurs in as technical, regulatory, institutional and legal aspects. The author indicates that motivations and security concern in a strategically level could explain the low progress and thus suggests institutional arrangements may be taken as a way out.

Sanguansue (2010), deputy director of Thailand's Department of Land Transport, proposes that laws and regulations are also important. The promotion and continuation of international cooperation policy should be considered the most sustainable way. He affirms that AEC and GMS has promoted a great progress on logistics, particularly between mainland Southeast Asia and Southwestern provinces of China. And CBTA is one of the key apparatuses that pave the way for international logistics liberalization serving an economic community by 2015.

From the perspective of learning lessons or experience from other comparatively successful regions or sub-regions, Willem van derGeest and Jorge Nez-Ferrer (2012) study European Union institutional structures. They indicate single policies with a clear mandate, strict guidelines, should be taken to foster integration and compensate for possible adverse effects. The paths for Asia should be different since customs union or common market integration have no legal, political or economic necessity to precede infrastructural cooperation.

Prabir De (2014) calls for achieving a single-stop and single-window customs along corridors through the efforts from the interaction between institutions and organizations. Also the author emphasizes the role of soft infrastructure, and the relevant rules, regulations, standards, and a common regional structure similar with the CBTA with an international design could help the realization of such purposes.

2.2 Institutional Risks to Connectivity

For the first time, ADB (2015) proposes that greater connectivity may aggravate the institutional risks in overlapping responsibilities, illegal migration and human trafficking, ethnic conflicts and insurgencies in border areas, and perceptions of unequal benefit, so compensatory mechanisms are required for offsetting accordingly through retooling the current institutions and creating new ones. Also, for better connectivity, a calibrated policy framework of soft infrastructure should be adopted by governments.

2.3 Financial Infrastructure

Biswa Nath Bhattacharyay (2012) discusses lessons that Asia could draw from EU in financing infrastructure in some initiatives (as defined in Footnote 8) pursuing for a high degree of integration of national financial markets by macroeconomic and fiscal policies, strict rules, common standards and rules to promote bond markets, clearing and payment systems and access for all national investment projects to deep and liquid markets.

Kwok- Chiu Fung, Alicia Garcia- Herrero, & Francis Ng (2012) propose the government involvement, ADB's role of coordinator, coordination of the diverse participants, and the comprehensive understanding of all the political and financial elments could greatly help the external benefits from transnational infrastructure projects.

From another access to the infrastructure financing, PPP, Willem van der Geest and Jorge Nez- Ferrer (2012) propose that PPP in Asia, as the experience in EU shows, should consider the level of risk- spreading perspectives of public investment to private operators, VAT and the percentage of remaining marginal benefits of private sector. By adopting of PPP in Myanmar, Hector Florento, & Maria Isabela Corpuz (2014) states that PPP could help delete the barriers to international investment. In this practice, what should be mainly considered are transparency in the bidding process, the limited

capacities of government in supervising and enforcing and limited involvement of international companies.

Prabir De (2014) propose that under the financial aid from PRC, Japan and Republic of Korea, PPP could be expected to mobilize savings for infrastructure development for the connection economic corridors and regional integration in GMS.

Yuwen Dai (2014), through investigation the determinants underlying the synchronization of business cycles between Asia and the PRC, Japan, and the US, certifies that the key role of ADB in connectivity in GMS and the GMS with the rest of world as well as the spillover efforts.

ADB (2015) indicates that PPPs is an important alternative for infrastructure funding in infrastructure finance, especially in cross-border financing. And a multipronged effort should be taken for more options for financing cross-border connectivity with much more attractiveness to private investors in south Asia and Southeast Asia.

2. Logistics Performance

The ultimate goal in developing the NSEC is, through improving economic development, living standards of the people along the corridor in the GMS can be promoted. Yet to reap the NSEC's substantial potential benefits, all members have to understand the challenges that will arise from the logistics performance in GMS and the surrounding regions in the process of integration.

3.1 In Regional Economic Integration

From the perspectives of regional economic integration, GMS and CAFTA are two mostly influential arrangements in South Asia. Douglas H. Brooks (2008) indicates cross-border and domestic infrastructure behind the border, their cooperation in infrastructure policies and institutions can therefore lead synergistically to a reduction in trade costs and time, which thereby inspire investment, trade, and growth. It is also testified that inland transport cost occupies about 88% of overall trade transportation costs in South Asia.

3.2 GMS

Manabu Fujimura (2004), through the case study of GMS, indicates that efforts to enhance intra-GMS integration are likely in compliance with the extra-GMS integration because such integrations are driven by the market rather than the official

institutions. Tariff barriers are suggested to be removed without bias.

Liu Jinxin (2006) proposes the Model of Regional Dual-nuclear structure in Yunnan and Thailand logistics cooperation from the theories of spatial economics based on transport costs comparison among three lines of transport of Jinghong-Chiang Rai. He concludes that transport via Mekong River is the cheapest way.

Christopher Edmonds. & Manabu Fujimura (2006) conclude the positive relationship of the quality of road infrastructure regional and national in the border and trade and investment in GMS. Trade flow does not associate significantly with the weighted average tariff rates.

Anna Strutt. Susan Stone. & Peter Minor (2008) indicate that the timeliness and cost of trade could be improved along the economic corridors under CBTA. Some indirect costs. including customs regulations. tariffs. and others cost due to lack of transparency may hinder the willingness of enterprises to do business here.

The evidence from Vientiane–Laem Chabang Corridor and Danang–Mukdaharn Corridor with regard to the time to shippers suggests that time and cost saving (25%–50%) and the growth of trade and economy could be expected from the progress of transport infrastructure and trade facilitation in the GMS. The best performance of logistics lies in Thailand. where about 26% of time could be saved at exporting fruits and vegetables to GMS countries. In the PRC, the overall reduction in time is about 25%. All these positive impacts are correlate with welfare and GDP.

Manabu Fujimura (2008) studies six local economic corridors via site visits in 2005 and 2007 and indicates that NSEC will benefit consumers, producers, and traders along this corridor in PRC and Thailand. But negative impact may be sensed by livelihood along Mekong River since some transport may revert to land transport. Farmers living in northwestern Lao PDR can also be the beneficiaries. Adversely. Djankov. Freund. and Pham (2008). delays in transit may have negative effects to landlocked Lao PDR. So. the competitiveness and value added in cross-border trade should be reached through the logistics services with good quality. especially when the production processes become increasingly fragmented.

Narong Pomlaktong. & Sumet Ongkittikul (2008) propose that in Thailand logistics improvement via the cross-border transport is not feasible due to the unclear implementation of CBTA. different transport regulations and related obstacles. including transit traffic. traffic rights' exchange. infrastructure standard and institutional framework. So the coordination and cooperation in both governments and enterprises should be undertaken and experience should draw from the case of Kunming-to-Chiang Rai Road.

Takafumi IWATA. Hironori KATO. & Ryuichi SHIBASAKI (2010). however. indicates that it is the port infrastructures. not the road development that drives the increase of the trade between the GMS and the world. although the land transport could benefit each members along NSEC and EWEC as well as Southern Economic Corridor (SEC) based on the full carrying out of CBTA. Also. the cross-border transportation projects help the growth of GDP. with Thailand and the PRC as the slight increase.

3.3 ASEAN and CAFTA

Song Hui (2007). from the perspective of the co-relationship between regional logistics and regional economy. adopts TEB (Traffic Economic Belt) as the basis to study the economic impact to Yunnan's economic impetus after commencement of Kunming-Bangkok Expressway due to the regional advantage of logistics costs. Comparison is taken among modes of transport from Kunming to Bangkok in terms of transport time. transport cost and transport capacity. Road transport is superior in transit time (about 2 days by road and 5-7 days by water or by sea) and in less transit cost (RMB 668 /ton. although the capacity of road is only 15-20 tons (80-250 tons by water). Thus the road transport via Kunming-Bangkok Expressway via Lao. taken into other uncontrollable factors as border-crossing charge. international driving license. crossing regulations and languages. would be the most competitive passage by road from Yunnan to ASEAN members and to Indian Ocean. Thus cooperation among China. Lao and Thailand is of great importance in signing and implementing the Agreement on Car Transportation.

Ma Tengfei (2007). from the geographical location of Yunnan to Thailand. studies how the Kunming-Bangkok Expressway does pave the way for the modernization of Yunnan's logistics in openness. extension of market share of Yunnan's

products to Thailand and integration in ASEAN. In particular, the expressway is expected to enhance the competitiveness of Yunnan's vegetables in Thai market through reducing the logistics time in crossing and cost in damages. Estimation is made for the export Yunnan's vegetables to Thailand by 10 times after the commencement of Kunming-Bangkok Expressway, amounting to 60,000 tons monthly. Thus Yunnan should cultivate large pilot logistics enterprises with integrated, professional service and with core competency before year 2010 and enhance the cooperation and connection with the logistics industries of ASEAN members.

Luo Shengrong, & Lin Sufang (2012), from the perspective of Thailand's position in AEC, analyze the development of Thailand logistics industry to certify the logistics performance index: logistics capability 3.29, customs procedures 3.02, infrastructure and technology 3.16 and international transport standards 3.27, which, in China, the index are a little higher as 3.49, 3.16, 3.54 and 3.31 respectively. In order to enhance the comprehensive performance of Thailand logistics industry, efforts should be taken with regards to reduce the logistics cost in distribution and information technology, to improve the infrastructure of road, waterway and air, to purse for the high-efficiency in logistics management direction and to cultivate the professional logistics talents.

Hal Hill, & Jayant Menon (2014) conclude that ASEAN is far from a economic entity and just a diplomatic talk-shop, dealing with framework agreements and plans.

Prabir De (2014) empirically proposes that harmonize laws and processes along economic corridors should be taken in regional integration, which will encourage more intra- and inter- regional fragmentation of manufacturing and services. And the economic corridors would help increase the benefit of integration if the logistics costs could be lowered.

Phoothamnong, S., & Wiboonrat, M. (2014), through the in-depth interviews, analyze the overall infrastructure affecting the mangosteen transportation from Thailand to China using R9 (as define in Footnote 9), along which Vietnam and Lao are not effective enough due to the regulatory authorities and process on crossing boarder. So suggestions are made in enlarging the regional cooperation within ASEAN, preparation for the AEC+3.

Wu Yanfeng (2014). through analyzing the current status of the logistics development in the China-ASEAN free trade zone and studies on its logistics standardization. points out the general line of thinking in the integrated logistics standardization of the zone to reduce the logistics procedures and cost.

Masahiro Kawai, & Kanda Naknoi (2015) propose that in order to boost the inward FDI. good physical infrastructure and low costs of doing business are considered as one of the key approaches in ASEAN. And this region should keep further integration with the rest part of the world and at the same time maintaining ASEAN centrality in AEC.

3.4 East Asia and Southeast Asia

Ganeshan Wignaraja et al. (2014) indicate that through building links to Southeast Asia, economic cooperation and investment in connectivity, welfare in South Asia and Southeast Asia could expect a rise by 8.9% and 6.4% of GDP in using an advanced computable general equilibrium (CGE) model, estimate the potential particularly for South Asia, assuming that the policy- and infrastructure-related variables that increase trade costs are reduced via economic cooperation and investment in connectivity. If the two regions-South and Southeast Asian succeed in 2030.

Economic corridors, important catalysts, have been considered by Richard Pomfret, & Patricia Sourdin (2014) as tools for boosting the production network in East Asia and Southeast Asia. So some measures should be taken to ease the logistics constrains along corridors, infrastructural development and nice environment for doing business. all of which require the support of government policies.

ADB (2015) indicates that customs operation should be Kyoto Convention. which is deemed as solutions to the current obstacles in trade integration. However, the ICT makes the gap in implementation of modern customs system due to the lack of such technology in less developed nations. Good border infrastructure, transparency. unified standards, facilitation measures, effective consultation mechanisms and participation of stakeholders (traders, carriers, and forwarders) can provide solutions to the trade facilitation.

3.5 Asia and Global Production Networks

Douglas H. Brooks, & Susan F. Stone (2010) conclude that the logistics performance in East Asia performs comparatively well in countries in Asian Asia-Pacific Economic Cooperation and both the hard and soft infrastructure could rise the quality of trade.

Ajitava Raychaudhuri, & Prabir De (2014) study intra-industry trade (IIT) index and indicate that lower trading cost does not entail the enhancement of production networks. And the physical infrastructure can inspire trade and movement of goods, provide access to markets and help enlarge the economies of scale and competition as well as reducing the logistics costs.

Mohammad Masudur Rahman (2014) highlights that economic corridors could facilitate trade and if Bangeladesh could open up its transport system for regional connectivity, the export will increase. So the author indicates that various measures should be taken for an effective economic corridors, namely, free cross-border investment, agribusiness development, infrastructural improvements, business development services in poorer areas, and full coordination of tourism initiatives.

Pushpa Raj Rajkarnikar (2014) proposes reform measures for developing economic corridors and trade. Such measures involve in customs, formalities, governance, institutions and dispute settlement and ways for trade facilitation. The author also stresses that with good transit regime and efficient institutions, economic corridors could be realized from transport corridors.

Selim Raihan (2014), throught the field survey in Bangeladesh, concludes that reducing trading costs in South Asia with faster transportation by enhanced physical connectivity could help the integration under SASEC (South Asia Subregional Economic Cooperation).

Shintaro Hamanaka (2014) indicate that the legal and economic impacts of ATF (Agreement of Trade Facilitation) to members, which can contribute to the development of trade facilitation capacities, but reforms in short and long terms may be conducted.

Sung Heun Ha, & Sang Won Lim (2014), after the study of cases of Thai Rice export, conclude that paperless trade can facilitate the integration, but the obstacles exist in common standards, legal framework, coordination mechanisms, capabilities' diversities, and cooperation between sectors.

ADB (2015) concludes that institutional mechanisms are required to offset the participants with less benefits and address the adverse effects in economic integration between South Asia and Southeast Asia. Thus cooperation at the regional levels of all perspectives should be conducted for such purposes.

From a new approaches to analyzing global value chains, Christophe Degain, & Andreas Maurer (2016) propose that infrastructure development and innovations in logistics services has been evidenced as efficient forces for GVCs. While the cross-border flows of goods could be inspired by reduction in the tariff in a sharp manner.

Galina Hale, & Bart Hobijn (2016) conclude that 55% of goods from the PRC in America covers the costs originated from wholesale, transportation, and retail components in the PRC. 4.2% of US private fixed investment spending has been taken for import from the PRC, while such percent for imported goods is 20%.

3.6 In Sino-Thai Trade

Chaipat Chainiramai (2011), based on the relationship between trade and logistics indirectly reflecting the need and trend of logistic capacity and the importance of Sino-Thai trading relationship under ASEAN, study the mount of trade and cargo between China and Thailand through Granger quantitative methods and qualitative methods to analyze the relationship of both nations. The result shows the logistic capability is larger than the pulling effect of trade on the logistics which laid the foundation for logistics development as a focal point, to develop bilateral logistics capabilities, and ultimately break through the logistics bottlenecks, and to promote the bilateral growth rate on trade. In particular, the author indicates that Yunnan and Guangxi provinces of China are the two accesses with critical strategically significance from Thailand to China, although the trade volume with them are far from significant at 3.7% and 1.4% respectively in Sino-ASEAN trade. The research also indicates that Kunming-Bangkok Expressway is inferior in cost of time and logistics (18% in total trading cost) based on the contribution ratio via the expressway remains at 1.04% to Sino-Thai trade volume, due to lack of standardized logistics performance and insufficient logistics infrastructures. Efforts should be taken to reduce the logistics cost, innovate customs regulations in China and promote the development of freight forwarders as well as establish the logistics parks.

Bhatcharabhorn Wimonsarawong (2014) conducts a comprehensive way to measure the characteristics of Sino-Thai trade and predict its prospect based on Sino-Thai trade value and volume as well as traded commodities in the year of 1992-2013. Particularly, the author indicates that higher logistics cost constitutes one of the disadvantages and barriers in Sino-Thai trade; the logistics expenditure consumes GDP by 14.3% in 2013 (as defined Footnote 10), accompanying damages to goods in the transmission and insufficient transport capacity as well as limitations to sea transport. Thus Thailand should enhance the logistics development comprehensively and loosen the restriction to ocean transport and improve the transport capacity by air.

Pornthipa Ongkunaruk, & Chonlachart Piyakarn (2011) study the logistics cost in transporting mangosteen from the eastern Thailand. Among all cost related, material handling takes the majority, approximately at 69.29%, of the total logistics cost, varied by size of farmers. And the transportation cost is about 16.29%, the second largest charges. In order to lower the cost in material handling, collaboration among farmers and collectors can be one of the solutions.

Nopprapun, Thanapon (2012) studies entrepreneurs' opinions and suggestions toward the use and development of regional land transport logistics focusing on Thailand and China with fresh fruit exporters 5 case studies. Statistically, Thailand has been China's largest fresh fruit supplier. In this regard, more than 90 percent of exports are shipped from Bangkok (and Choriburi) to the port of Hong Kong before passing to Jiangnan fruit market in Guangzhou. Only few portions are pertaining to other freight channels as Cruising along Mekong River (2%), Travelling on cross-border Roads (9%), and Freighting by Air (<1%). Two major reasons hampering Thai exporters employing the present land transport logistics are; first, the lack of information (1.73) (as defined Footnote 11) about the routes and procedural operation. Another is its poor smoothness and low reliability (1.70). Only one superior advantage of land transportation agreed by exporters is it has better accessibility to explore Chinese markets, especially its southwestern potential economies as Guangxi and Yunnan. With this channel, fruit can be freighted from and to Southwest China by only 2-3 days compared to a week on shipping via Hong Kong and Guangzhou.

Concerning the way to develop such channel, majority of exporters stress on four issues: first, they want the government to provide more information (4.43) which is not diplomatic but pragmatic facts. Second, they suggest the government to deregulate (4.67) some redundant laws and regulations, especially to standardize principles used in related countries along the path. Third, they appeal for more transparent (4.24) and efficient operation. And finally, they hope all countries could honestly hold their active stance (4.27) in cooperation afterwards.

Xia Wenqiang (2012), on the basis of analysis of Sino-Thai rice trade and logistics situation and existing problems, studies Kunming as Sino-Thai rice logistics distribution center with regard to the Sino-Thai rice logistics and transport routes. Through the road transport, the exporters deliver the rice to ICD (Inland Container Depot or Inland Clearance Depot). The waterway is the dominant mode of transport for rice. The research emphasizes the geographical importance of Yunnan in access to Indian Ocean by road and shows the four road passage and 3 water corridor from Yunnan to Thailand and the cost of modes. The result shows that the 8th route (Bangkok- Chiang Mai- Chiang Sheng- Simao- Kunming) is the best alternative for rice logistics in terms of lowest logistics cost at 65.4026.

Sung Heun Ha, & Sang Won Lim (2014), study the exporting Jasmine Rice from Thailand to the US and indicate that complexity of documents' requirement should be replaced by paperless, which could save the time and cost in border-crossing and the overall trade.

3.7 In Regional Cross-border Logistics Network

Xiao Zhuo (2007), taking the perspective of regional logistics system, studies the Yunnan's logistics system open to south Asia and south-east Asia and optimization of the logistics system. The author explains the related theory of logistics industry, regional logistics, regional logistics system optimization and the situation of the logistics system in Yunnan. Compared to GuangXi Autonomous Region, which has many characteristics in common with Yunnan, the author analyzes the regional logistics advantages of Yunnan Southeast Asia and South Asia Region in road access to ASEAN countries with less logistics cost and time and road infrastructure. Then the forecast of GDP and logistics rate to GDP are taken as RMB 7918400 billion and 15.5% respectively. Based on the data of cargo volume and GDP in the year of 1994-2003, the

cargo volume prediction of growth, through regression, is 5.57% in year 2010-2020. At the same time, potentials in border-crossing will entail more logistics demand from ASEAN members. Starting from the regional logistics demand of Yunnan, the author explains the main factors (GDP, Labor and Capital) affecting demand in the theory and practice, and analyzes the potential logistics requirements for optimization in logistics nodes, logistics park, distribution centers, transport network and corridors of modes linking ASEAN countries, which Kunming-Lao-Bangkok corridor is one of the four corridors. The author emphasizes that road corridor plays important role in distribution and colleting cargoes, especially involved in openness to ASEAN countries.

Ruth Banomyong (2008) indicates that in the western sub-corridor linking Kunming and Bangkok, weak border crossings are still the obstacle, and the cost at border crossings is more than the transport charges in the rest legs of the journey. Such constrain will hinder the transmission of this corridor into the economic corridor.

Dai Shiqing (2010) addresses the strategically important position of Yunnan province for the access to Indian Ocean and to ASEAN countries and suggests that Yunnan should establish the modern logistics industry in the aspects of logistics scopes, nodes, enterprises, markets and basic activities.

Zhang Yiwei, Sun Liangtao, & Li Jiyun (2013) Study on China-Vietnam border logistics system for the general characteristics of the border trade logistics based on China-Vietnam trade between the years 2002 and 2011. The study shows that the cargo logistics keeps higher with diversified modes of transport, high cost in crossing and warehousing and complicated customs procedures and fluctuation due to political stability. Improvement should be taken in infrastructure, logistics standards and IT.

Zhang Biqing, & Su Yi (2012) study the cross-border logistics between Yunnan and Vietnam based on the border trade in the year 1992-2010. They predict that Yunnan-Vietnam trade and border logistics cargo are USD 1814482000 and USD2867129000 and 3973700 and 627900 tons.

Chiranjib Neogi (2014) points out that trade and regional development through agglomeration of industries could be facilitated by developed infrastructure in the border region by cost and time reduction. Human capitals are also the requirements for this facilitation.

ADB (2015) proposes that Myanmar is the place where physical barriers to cross-regional transport take place, concerning the connectivity system by road, maritime and rail. Lao PDR is another gaps for the connectivity. And road and rail transport networks are constrained by less capacity and far from efficient.

Conclusion of the Review

Since systematical literature reviews aim to draw the body of literature, to summarize them objectively and identify potential research gaps, both statistics and illustrative results are to be shown separately for the purpose of comprehensive understanding of the status quo.

1. Summary of the Review

From the bibliometri review, main findings could be summarized as below. In general, although international logistics is becoming a hot issue in the field of international trade and logistics, targeted and systematic research in logistic performance along North South Economic Corridor of GMS has not been realized. In particular, the fluctuation trend may imply that the researches are lack of stable and continuous study, which may make the further cooperation or measurements among members of GMS lagged. Thus more focus could be relied on this specific study and/or there is much space to improve the academic expertise in this topic.

Also, taking from the aspects in LPI, indicators of time and cost are the focus to be studied. In addition, further study could take the theoretical perspective as one way ahead. The theory of international logistics impacts on international trade is not matured. We have known a high association between improved logistics performance and increased trade, but we need get to understand individual factors of international logistics in terms of impacts on international trade. In particular, point-axial system theory in designing key hubs in a subregion is to be certified in a comprehensive way.

Further, the statistics indicating contributing sources of literatures organizations (ADB and ADBI) are more expertise with fruitful and influential research reward. This may suggest that Asia Infrastructure Investment Bank (AIIB) could draw on this module or cooperate with other research giants. And universities in China, especially those in Yunnan province, could enhance the academic quality through cooperation and taking researches by professionals.

While, from chronological way. In terms of the estimation of demand and impact, limitation could be witnessed in the following ways:

Firstly, some estimates do not take into account any country strategic planning to invest in infrastructure. Secondly, few have estimated the actual cost reductions associated with these investments of physical infrastructures. Thirdly, assuming full implementation of the CBTA is the background of such estimations, however, CBTA is still suspended. Fourthly, when taking the GMS as a whole to study, the indicators of the PRC have been substituted by Yunnan and Guangxi, a small part of the overall PRC, and the two provinces are mostly not the origin or destination in export and import. Fifthly, serious data in the GMS includes certain share of informal trade, which cannot be collected with accuracy and timeliness. Sixthly, separation of regional transport with national infrastructure is difficult to realize due to the data collection. Seventhly, some assumptions like perfect competitive markets, full implementation of CBTA are not the actual situations or scenario and lastly, short-term impact could not be supported well by subjective data.

2. Implication

Concluded from the limitation of existed reviews, the future research should be taken from the below perspectives:

Firstly, models for estimation of demand and impact should be innovated or improved. One of the concerns is the accuracy of data, which should be updated and includes in individual sectors related and cross-sectors to show more accurate circumstances. Thus field research, interviews and panel survey could be takes as complemented approaches. In particular, the real indicators of Yunnan province and Guangxi Zhuang Autonomous Region should be further confirmed, rather than abstracting some certain percentage of that of the whole China as indicators. Secondly, the relationship between the regional and national transport infrastructure should be studied with priority. And how to make or link the national and subregional infrastructure support and complement each other. Thirdly, the equity of cost and benefit distribution is another concern worthy of the same priority as the proceeding one, which should base on the study of cost-efficiency analysis of the each members. The two aspects are with the less literatures but the most critical concern. Fourthly, how the positive impact in reduction of time and cost in the GMS with the rest of the world has

been proposed but suspended. Fifthly, without the prerequisites of implementation of PPP but with obstacles of bond market in most GMS members, what are the solutions to the biggest challenges of financing and investment in a long run? Sixthly, in terms of cross-border, how can we find ways to introduce the illegal or informal border trade into legal and formal undertaking, and how to realize the CBTA into full implementation? Lastly, how to minimize economic and non-economic negative externalities coming from increased connectivity?

In addition, although a lot of researches have been started regarding the Thailand-Yunnan logistics from a broad way, there is still much space to study or study it further. Taking from the perspective of LPI, a comprehensive set of evaluating the performance of logistics, there are some fields to be studied in the seven indicators, some of which have not been stepped on, and some of which still need to be studied further.

2.1 Efficiency of the clearance process by customs and other border agencies

Efficiency of the clearance process by customs is one of the main focuses in previous research by quantitative analysis, while little research in border agencies is taken. Further research can on the one hand, look for the quantitative analysis in the relationship between efficiency of the clearance and logistics volume, and on the other hand, begin to learn the efficiency of border agencies.

2.2 Quality of transport and information technology infrastructure for logistics

Little research is found in the quality of information technology for logistics, which can be taken for future research.

2.3 Ease and affordability of arranging international shipments

The research of this indicator is unavailable, although seldom is the study of the multimodal transport in time and cost only.

2.4 Competence of the local logistics industry (e.g., transport operators, customs brokers)

The logistics industry in Yunnan and Thailand have been studied from a broad way, the focus of which are not related to transport operators' and customs brokers' competency. Research in the future could find the way here.

2.5 Ability to track and trace international shipments

Contents in this indicator have not been started academically, which leave a spatial room to research in the future.

2.6 Domestic logistics costs (e.g., local transportation, terminal handling, warehousing)

In domestic logistics costs, terminal handling and warehousing are seldom found, thus they could be analyzed quantitatively.

2.7 Timeliness of shipments in reaching destination.

Time of the shipment has been studied, timeliness, however, has not been studied yet. Timeliness could be studied in air transport.

The further research could be conducted due to the following reasons: Firstly, all researches assume that logistics volume is equal with either cargo traffic or trade volume. More accurate database is worthy of being investigated. Secondly, most of data should be updated due to the data belongs to the history. Thirdly, researches could not focus on the data for Trans-Asia Railway due to of data omission in the past years. And lastly, the data has been collected from the macro-way except research by Manabu Fujimura (2008) Much attention should be focused on the micro-way of data from logistics related enterprises.

Therefore, it could be concluded that there are lots of works to be done for full and objective understanding of this field. In particular, the logistics performance along NSEC has not been taken fully to all aspects; the potentials of NSEC have not been taken and the solutions to constraints have kept in governmental cooperation as the first step.

To be brief, the future researches should, based on the current physical transport infrastructure, except some missing links, focus more on the "software" transport infrastructure and propose measurable, feasible, acceptable, equal solutions for smooth connectivity in GMS, which constitute the specific research targets in the field of efficient transportation connectivity.

CHAPTER III

ANALYSIS OF METHODOLOGY

Based on the result in Chapter 2 and in order to finalize the targets in this thesis, this part aims to demonstrate what kinds of methodologies are to be adopted for the above mentioned two tasks: assessing the logistics performance along NSEC and predicting the cargo volume along this corridor in the future years 2016-2026, which pave the way for the third task of finding out the obstacles and then proposing the suggestions accordingly. And both the quantitative and qualitative approaches are to be employed successively. Quantitative approach in this thesis consist of time-cost model and fuzzy linear regression for assessing the logistics performance along NSEC and predicting the cargo volume along this corridor in the future years 2016-2026 separately.

Quantitative Approaches

Based on the assumption that the international trade between Thailand and Yunnan is the basis of logistics operation, shippers or consignors and consignees (as defined in Footnoted 12) require efficient logistics for satisfying requirements of customers, which is the better access to the regional market and global market for both Thailand and Yunnan. Along NSEC, major infrastructure investments have been improved physical connectivity between neighboring countries. The cross-border cooperation among GMS members, or the software connectivity, however, keeps constraining economic corridor development and integration. Thus a logistics corridor, like NSEC, focuses not only on the physical linking but also on how to mobilize the flow and storage of freight, people, and how to optimize vehicles in the corridor with the support of capable service providers and a facilitating institutions or agencies. In order to work out solutions to constrain or challenges along NSEC, a tool to analyze bottlenecks is needed to identify the current logistics operation or performance along NSEC, to illustrate the cost and time components by available routes and modes as well as the delays at borders or other inspection points.

1. The UNESCAP Time/Cost-Distance Model

1.1 Logistics Performance Index

In order to study the logistics performance, the World Bank takes six components of LPI for illustrating.

1.1.1 Customs. The efficiency of customs and border clearance.

1.1.2 Infrastructure. The quality of trade and transport infrastructure.

1.1.3 Ease of arranging shipments. The ease of arranging competitively priced shipments.

1.1.4 Quality of logistics services. The competence and quality of logistics services—trucking, forwarding, and customs brokerage.

1.1.5 Tracking and tracing. The ability to track and trace consignments.

1.1.6 Timeliness. The frequency with which shipments reach consignees within scheduled or expected delivery times.

From the perspective of supply chain, the reliability is a major concern for traders and logistics providers alike. Consignees require more certainty about when and how deliveries will take place. This increases the demand for quality in logistics services, posing challenges for private agents and for governments in both cooperation in policy making and practical operation. Such cooperation has been highlighted in the efficient border management, which is critical for eliminating avoidable delays and enhancing predictability in border clearance.

Such concern is much more significant along NSEC, the main passage of such perishable goods as fruits and vegetables between Thailand and Yunnan, which are time-sensitive consignments. Thus the transit time of the whole logistics process has been regarded as the first priority when assessing the logistics performance. In addition, along this corridor, the whole route involves transportation of cross-border, where the customs clearance and inspections for goods, vehicles and passengers have to be taken place, in according to the rules and regulations in Lao PDR, Thailand and/or PRC as well as the conventions for cross border transportation. Such operations related must have posed great challenges to the whole transport process.

Under such circumstance, when adopting the LPI as the tools for discussion of the logistic performance along NSEC, the six components should be interpreted from the consideration of the transit time. That is to say, to study the

efficiency of customs and border clearance, we must firstly find out how long and the operation at customs may take and how much percentage of this part may occupy in the whole transit time. based on the infrastructure development or the basic connectivity and access. Before such operation, how difficult and how long will the consignment could be loaded. from the time of booking with the trucking or forwarding agents and getting familiar with each step into well implementation as planned, till to the points consignees requires, are related with time closely. At the same time, the cost should be interpreted into the transit time for the appropriate understanding of what logistics pursues for in cost-effectiveness concern. Requirement in time without cost may deviate from what the trades, forwarders and brokers consider at the first place and must go far from the expectation when this corridor has been designed.

Therefore, to evaluate the logistics performance along NSEC is to study the time and cost over distance. which could be understand more specifically with the six components as analyzed in LPI by World Bank.

1.2 Introduction to Model

The cost/time methodology, the graphical representation of cost and time data associated with transportation. based on the premise that the unit cost of transport varies between modes, is to identify the inefficiency and isolate bottlenecks along a particular route through observing the time and cost characteristics of every section (as shown in the below Figure).

Thus the time-cost model (Graph in Figure 9) could help comparison of the changes of cost and/or time required for transportation. alternative transit routes and evaluating the competing modes of transport operating on the same route. At each intermodal transfer point there will be a cost (or time) increase represented by a vertical step. Should a border crossing occur along the route. the border crossing charges (and time spent) can be represented by another vertical shift upwards in the cost curve at that point. which can then be cumulated with other costs. While. as the routes of NSEC shows (in Figure 5). this corridor stretches via Lao part at Chiang Kong-Huaxay from Thailand to Lao PDR and Boten-Mohan from Lao PDR to PRC. where transshipment of cargoes and vehicles must have been taken so that there must require cost and time at these two border crossing. accumulating the increase with both time and cost.
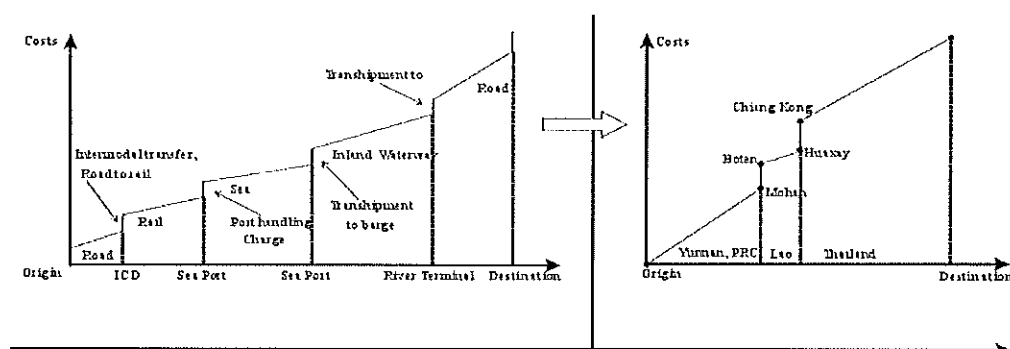
Figure 9 Time-Cost Model and Application

Source: Modified from José María Rubiato Elizalde et al., 2012

In addition, through a detailed breakdown of cost and time associated with border crossing, policy makers or private sections could focus on the critical issues in the whole process of transportation. In addition, the logistics performance could be estimated through the inclusion of cost in specific import or/and export industries. Further, this approach paves the way for the national stakeholder to track time and cost issues, in which they can identify the bottlenecks and barriers accordingly. What's more, the information or data on time-cost may reflect certain and general facilitation of policy decision in both trade and logistics from such macro perspectives in routes' prioritization.

So we can see that the model is to set for proposing a methodology, illustrating the cost and time components of door-to-door movement by available routes and modes, in which the delays at borders or other inspection points up to the point of destination within a transit transport corridor can be explained via graphs. In addition, the model includes costs and time associated with transport by any mode and with transfers between modes for multimodal transport which the strength of each alternative is utilized. And its most distinguishing characteristics relies on the transshipment at terminals where cargo handling between short-distance and long distance traffic are efficient in safer, faster and economical perspectives through reducing cargo handling. Such high efficiency is supported by reduced costs over road trucking, the key operation for inter-continental use, which can be offset by reduced timings or road transport over shorter distances.

Therefore. for assessing the efficiency of transportation. cost and time are two key factors to be studied. and they are what the time/cost-distance model aims to present. also they are what the assessing of logistics performance along NSEC requires in nature.

1.3 Data Required

Time. cost and distance are the key data required by time-cost model. In particular. preliminary information required includes the transport route including place of departure. any kind of stops (e.g. border crossings) and destination . the type of goods transported as well as the quantity and/or value. Along the NSEC. the large majority of international trade is between Thailand and PRC via Lao PDR of. fruits and vegetables in both directions. although this trade is highly volatile due to seasonal fluctuations. And most products traded from PRC to Lao PDR are construction materials and equipment as well as vehicles. Northbound trade is agricultural products such as fruits, rice, etc..

Thus this methodology may expect two individual graphs of both time and cost over distance. With time plotted against distance, the relative speed of transit transport for each leg can be indicated for comparison. and the bottlenecks can be distinguished in border crossing points for transshipment. The higher the step, the more likely the border crossing is a constraint. Similarly, the cost data are also plotted against the distance for each leg. The figures show the relative costs of each leg or mode, as well as implies the approximate portion of non-transport costs in relation to transport costs.

2. Fuzzy Linear Regression

Traditional regression models take the deviation between the true value and predicative value as the observation difference. while the fuzzy regression approach regards such deviation as the fuzzy of parameters of the model's system. Although there remain unexpected obstacles along NSEC. it is necessary to estimate the freight volume in order to match the possible measures of overcoming the existing constraints of efficient transport connectivity and planning for policy makers. Such prediction should take the past data -the fixed history data as the reference. set up predicative model. and forecast the key parameters to conclude the analogue figures.

2.1 Determinants of Freight Volume

For the forecasting itself, the freight volume of road has close relations with the local economy so that the forecasting of freight volume along NSEC must take determinants or influencing factors into care consideration. From the perspective of theory, more determinants will make the model of forecasting more accurate, from which the model would be complex and may go far away from the prediction. Further, too much determinants will result in the incomplete dependence among these determinants, which will lead to the difficulties in calculating. Thus it is critical to choose these determinants within manageable scope and with dependent correlation.

Thus some indicators are chosen to estimate the correlation with the road freight volume, such as GDP, POP, infrastructure investment, FDI and trade complementarities. In this research, Grey Correlation (GRA, by Deng Julong in 1980s) (as defined in Footnote 13) is adopted to calculate the correlation of freight volume with each indicator. More details of GRA application for correlation are as followed procedure.

Firstly, taking the initial value of road freight volume (m group) and 5 indicators as a dimension; set

$$Y= \{\frac{y(1)}{y(1)}, \frac{y(2)}{y(1)}, \cdots \frac{y(i)}{y(1)}, \cdots \frac{y(m)}{y(1)}\}$$

$$P(j)= \{\frac{x(j1)}{x(j1)}, \frac{x(j2)}{x(j1)}, \cdots \frac{x(ij)}{x(j1)}, \cdots \frac{x(5m)}{x(j1)}\} \quad (1\leq i \leq m, \quad 1\leq j \leq 5)$$

In above equations, Y is the first reference sequence of freight volume dimensions; P_j is the compared dimension of the jth indicators' dimension (the first one); Y_i represents the actual date of freight volume in the i group; X_{ij} indicates the data of jth indicator in the i group. Here i and j are integers.

Secondly, calculate the difference between the reference sequence and the comparison of sequences, that is,

$$\Delta(ij) = |Y(i)-P(ij)|$$

$$Y(i) =\frac{y(i)}{y(1)}$$

$$P(ij)=\frac{x(ij)}{x(1j)}$$

For above equations, $Y(i)$ is the data in i group of reference sequence; $P(ij)$ is the value of the jth indicator in the ith group in the sequence of comparison; and the $\Delta(ij)$ is the difference between the data in i group of reference sequence and the value of the jth indicator in the ith group in the sequence of comparison.

Thirdly, working for the correlation coefficient, that is,

$$\varepsilon(ij) = \frac{\Delta min + \rho \Delta max}{\Delta(ij) + \rho \Delta max} \quad (\rho = 0.5)$$

ρ is the recognition differential for avoiding the distortion due to high data of Δmax; $\varepsilon(ij)$ is the correlation coefficient between the value of the jth indicator in the ith group and the freight volume in the ith group; Δmax is the maximum value of $\Delta(ij)$; and Δmin is the minimum among $\Delta(ij)$.

Lastly, getting the GRA, that is,

$$E(j) = \frac{1}{m} \sum_{i=1}^{m} \varepsilon(ij)$$

$\varepsilon(j)$ refers to the GRA between the jth indicator and the road freight volume y.

2.2 Set-up of FLR Model

The FLR model is needed to evolve to the forecasting model for road freight volume. Judged from the classical regression analysis, the deviation between the forecasting value and the actual data is the observation error, which could be deemed as the fuzzy error since the input data and the output value are obfuscated. Thus, the relation between the road freight volume y and the social indicators is supposed as below

$$y = A_1x_1 + A_2x_2 + A_3x_3 + A_4x_4 + A_5x_5 \tag{1}$$

In this equation, x_1, x_2, x_3, x_4 and x_5 represent Infrastructure Investment, GDP, POP, trade complementarities and FDI respectively. And A_1 to A_5 are the coefficients of counterpart of x_1 to x_5 accordingly.

In the equation (1), the A_1 should be regarded as the fuzzy coefficient in case of the regression analysis of this equation. Thus the deviation of forecasting

originates from the fuzzy amplitude, which can be demonstrated as a triangular fuzzy number

$(A_j \ (a_j, \ c_j))$ with the subordinate function like,

$$\mu A_j = \begin{cases} 1 - \dfrac{|z-a_j|}{c_j} & a_j - c_j \leq z \leq a_j + c_j \\ 0 & \text{others} \end{cases} \tag{2}$$

For the above equation, z is the precise value of A_j; a_j is the central value of A_j and c_j is the fuzzy amplitude of A_j.

Therefore, the road volume y_i in the ith group could be witnessed as the following subordinate function as

$$\mu_{y_i} = \begin{cases} 1 - \dfrac{\left|y_i - \sum_{j=1}^{5} a_j X_{ij}\right|}{\sum_{j=1}^{5} c_j |x_{ij}|} \\ 0 \quad others \end{cases} \tag{3}$$

$$\left(\sum_{j=1}^{5} a_j X_{ij} - \sum_{j=1}^{5} c_j |x_{ij}| \leq y_i \leq \sum_{j=1}^{5} a_j X_{ij} + \sum_{j=1}^{5} c_j |x_{ij}|\right)$$

2.3 Model Solution

When analysis is to be taken through the above equation (1), two assumptions should be met.

Firstly, for any set of variables $(y_i, x_{i1}, x_{i2}, \ldots, x_{ij}, \ldots x_{i5})$, set a parameter H $(0 \leq H \leq 1)$, so,

$$\mu y_i \geq H \tag{4}$$

Secondly, fuzzy coefficient A_j has the fuzzy amplitude D as

$$D = \sum_{j=1}^{5} c_j X_{ij}$$

So to calculate the minimum D is to get fuzzy coefficient A_j.

$$\min D = \sum_{j=1}^{5} c_j X_{ij} \qquad (5)$$

$$\sum_{j=1}^{5} a_j X_{ij} - (1-H) \sum_{j=1}^{5} c_j |x_{ij}| \leq y_i$$

2.4 Goodness of Fit

Seeking for solutions to the equation (1), certain standard should be adopted for the goodness of fit of the model through subordinate function μ_{y_i}, which represents a good degree of fitting in case that the value is bigger than 0.5.

$$\Phi_1 = \frac{\left| y_i - \sum_{j=1}^{5} a_j X_{ij} \right|}{y_i}$$

$$\Phi_2 = \frac{\sum_{j=1}^{5} c_j |x_{ij}|}{y_i}$$

When the Φ_1 and Φ_2 is within the scope of 30%, the goodness of fit is to be acceptable (Φ_1 is the ratio between the standard deviation (from the forecasting and actual value of road freight volume) and the actual value; Φ_2 is the ratio between fuzzy amplitude and the actual value of road freight volume.)

2.5 Deviation Analysis

When the deviation is compared with other methodology of forecasting, this paper adopts mean absolute deviation(MAD), maximum relative error (MMRE) and Mean Relative Error (MRE) for comparison.

Thus the MAD in the fuzzy linear regression model is

$$| \bar{e} | = \frac{1}{m} \sum_{i=1}^{m} |e_i| = \frac{1}{m} \sum_{i=1}^{m} |y_i - y_{oi}| \qquad (7)$$

e_i is the absolute deviation in the ith group and y_{oi} is the correspondent forecasting value.

And the MRE is to be

$$\bar{\varepsilon} = \frac{1}{m} \sum_{i=1}^{m} \left| \frac{ei}{y_i} \right| = \frac{1}{m} \sum_{i=1}^{m} \left| \frac{y_i - y_{oi}}{y_i} \right| \qquad (8)$$

So the relative deviation and the MMRE are respectively

$$\varepsilon_i = \frac{y_i - y_{oi}}{y_i} \qquad (9)$$

$$\varepsilon_{max} = max(\varepsilon_i) \qquad (10)$$

Qualitative Approach

As mentioned above, a regional logistics system consists of four components - cost efficiency, responsiveness, reliability, and security (Banomyong et al. 2007). If the performance of NSEC is to be assessed, the four elements are to be determinants in a complete whole set. Thus qualitative approaches are needed to cover the responsiveness, reliability, and security for a comprehensive understanding the logistics performance along NSEC.

For this purpose, interviews are to be conducted for information complementary to the quantitative analysis. There are two parts in the interview (see Appendix B), one is for the logistics performance and another is for potentials along this corridor. In the part one, focus are put on reasons why the less efficiency occurs at customs clearance directly related its process such as required charges under-table, documents complexity and working efficiency and proficiency and the easiness of cargo handling and other indirectly associated adverse factors like the timeliness, the security, facilities and barriers in languages and standards. Also, how to improve the connectivity are to be expected from interviewees. And part II is designed for the prospects of NSEC. What are the positive influencing factors and how to exploit the potential are to be set accordingly.

The interviewees are selected from both theory and practice concern, with the latter as the focus. Thus professionals, including 20 academic associate professors or professors, 25 logistics companies along this route, 2 research associations in Yunnan province and 3 experts from ADB, are interviewed via calling or face-to-face meeting.

20 professors are all professionals in international logistics, including 16 associated professors and 4 professors, in which 16 associate professors (as defined in Footnote 14) are from Yunnan and Guangdong Province of PRC, and the rest four professors (as defined in Footnote 15) from Thailand. Further, the 25 logistics enterprises (as defined in Footnote 16) are chosen from both China and Thailand, who have operated directly and indirectly the cross-border transportation along this corridor.

The two associations are GMS logistics center, Kunming and The Chartered Institute of Logistics, Yunnan, both who are top logistics associations in Yunnan province. In addition, this interview is supported by Dr. Jean-Francois Gautrin, Dr. Paul Apthorp from Consulting Regional Cooperation, ADB, Kuala Lumpur, Malaysia, and Mr. Jeff Procak from Public Management of ADB discussed such topic with further details at Kunming.

CHAPTER IV

DATA AND INFORMATION

This chapter aims to finalize the logistics performance and cargoes predication along NSEC from both quantitative and qualitative analysis mentioned in chapter three. What comes first is data's collection, analysis, input for setting-up time-cost model and fuzzy linear regression model. Thereafter, results are to be presented accordingly. After both quantitative study, the statistic result and analysis of the interview is to be presented. And the end of this chapter is the brief summary of the logistics performance and cargo potentials along NSEC.

Time-Cost Model

1. Introduction to Data

The following Table 7 demonstrates the first set of data (2016) required.

Table 7 Time and Cost over Distance along NSEC

Cruise	Length (kilometer)	Time (approximate hour)	Total Cost (Yuan/Tonne)
R3A:Kunming-Mohan(PRC)	663	13	350
Mohan-Boten (PRC to Lao)	4	4	5
R3A:Boten-Huaxay (Lao)	215	2	118
Huaxay-Chiang Khong (Lao to Thai)	5	2	7
Chiang Khong-Bangkok	848	14	186
Total	About 1735	35	About 666

Source: ADB. 2016

2. Models' Results

The time-distance and cost-distance graphs (Figure 9 and 10) are to be illustrated in this part based on Table 7.

2.1 Time over Distance

As the graph 10 shows, there are two sudden jumps, where are the two border-crossing points of Boten and Huaxay. In particular, the time at Boten (Yunnan, PRC to Lao PDR) costs more than that of in Huaxay (Lao PDR to Thailand). Except the two points, the time develops evenly as the distance adds. In addition, transport of one kilometer in average in general requires about 0.02 hour, in Yunnan about 0.019, in Thailand about 0.165, while the data in Lao part is about 0.04, two times than the one in general average and more than two times than those of in Thailand and Yunnan. From another way, time in two points constitutes about 23% in total, while the distance in this part only occupies about 13%.
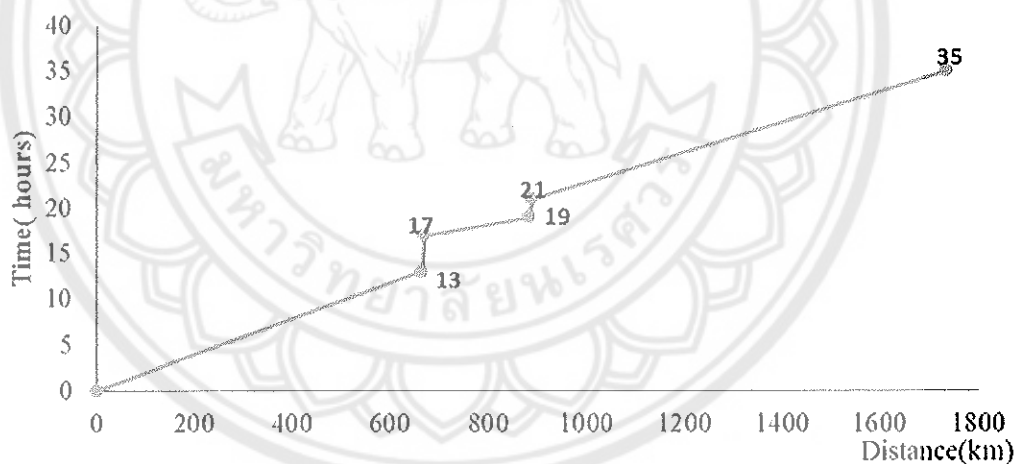
Figure 10 Graph Time-Distance

2.2 Cost over Distance

As the graph 4 indicates, the line develops smoothly with the unchanged slope in general, with two points of Boten-Huaxay, Huaxay-Chiang Kong as the exception, where the average costs are about CNY 0.55 and 1.4 /ton/kilometer. The two points though, do not fluctuate as big as those in Figure 10. And the cost in Yunnan is

about CNY0.53/ton/kilometer, in Thailand about 0.22, the least part in general, while the total average along this corridor about CNY 0.38/ton/kilometer. It should be beneficial to point out here that the processes at two border-crossing (into and out-of Lao) and transportation within Lao will be about 20% of total cost but only 13% of total distance.
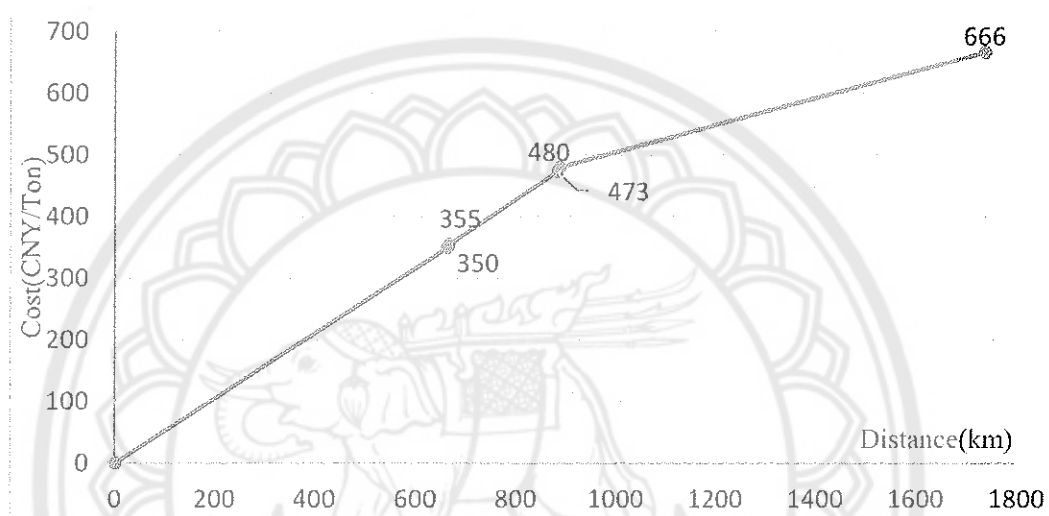
Figure 11 Graph Cost-Distance

Table 8 Comparison of Modes in Distance & Time (Kunming to Bangkok)

Mode	Capacity	Cruise and Time by Days
Multi-transport via road & ocean	(as per the vessel capacity)	Laem Chabang Port -Hong Kong-Guang Zhou-Kunming 8-10 days
Multi-transport via road and waterway	80-250 tons	Bangkok-Chiang Sheng-Guanlei-Jionghong-Kunming about 5-7days
Road Via NSEC	15-20 tons	Bangkok- Chiang Mai- Chiang Rai- Chiang Khong- Huaxauy- Mohan-Kunming about 3 days

As the table shows, the fastest arrangement for shipment of goods from Bangkok to Kunming is road transport via NSEC, which is suitable for transport of perishable goods like vegetables and fruits, the majority commodity forwarded along this corridor.

3. Models' Summary

Therefore, adopting UNESCAP Time/Cost Methodology, from the perspectives of time and cost over distance, the most critical elements of logistics performance, we can conclude that much more percentage of time and cost are taken by the section of NSEC in Lao PDR at the two border crossing points, where non-value added procedures such as transshipment, loading and unloading, documents processing for customs clearance, inspection and quarantine are taken. However, NSEC is the fast access from Thailand to Kunming, compared with multimodal transport of road and waterway or ocean. So NSEC is the best choice for transport of perishable cargo between Bangkok and Kunming but improvement must be made in Lao PDR as the first priority at two border crossing points. The performance in Yunnan province is also the concern to be enhanced.

Cargo Forecasting

1. Introduction to Data

In usual case, the data related with the freight volume in international trade are consisted of GDP, POP, FDI, and trade volume or value and road tonnage. The NSEC, however, are mainly the passage for vegetables and fruits in trade between Thailand and Yunnan (ADB, 2016), thus this predication deletes the parameter FDI, which is less involved in the trade of fruits and vegetables and occupies high percentage of GDP in Thailand case (see Table 9) and thus is detrimental for the predication result provided that GDP and FDI are the two parameters for forecasting.

Table 9 FDI Inward Percentage of GDP, Thailand and Yunnan (2001-2015)

	Thailand			Yunnan, PRC		
Year	GDP	FDI	Percentage	GDP	FDI	Percentage
2001	115.54	34.75	30.08	25.83	0.65	2.52
2002	126.88	39.92	31.46	27.94	1.12	4.01
2003	142.64	51.18	35.88	30.88	1.68	5.44
2004	161.34	55.15	34.18	37.24	1.42	3.81
2005	176.35	62.83	35.63	42.26	1.74	4.12
2006	207.09	80.54	38.89	50.02	3.02	6.04
2007	246.98	96.56	39.10	62.74	3.95	6.30
2008	272.58	96.64	35.46	81.92	7.77	9.56
2009	263.71	110.07	41.74	90.32	9.10	10.1
2010	318.91	142.50	44.68	106.70	13.29	12.50
2011	345.67	150.52	43.54	137.63	17.38	12.63
2012	365.97	159.12	43.48	163.32	21.89	13.40
2013	400.92	185.46	46.26	184.96	25.15	13.60
2014	422.29			198.82		
2015	413.00			216.12		

Notes: GDP and FDI are calculated in billion US$. Percentage is indicated by %.

Source: calculation by authors based on www.tcpdf.org.

Thus in this paper, the selected parameters for prediction are GDP, POP, road freight tonnage and trade value. Their statistics are shown in Table 10 and 11.

Table 10 Statistic Data of GDP, Road Freight Tonnage and POP (2006-2015)

Economies	Thailand			Yunnan, PRC		
Year	GDP	Freight	POP	GDP	Freight	POP
2006	207.09	427,581	63.16	50.02	606,140	44.83
2007	246.98	428,123	63.32	62.74	655,370	45.14
2008	272.58	424,456	63.48	81.92	391,190	45.43
2009	263.71	423,677	63.63	90.32	407,650	45.71
2010	318.91	420,449	63.79	106.70	456,650	46.02
2011	345.67	406,538	64.08	137.63	541,860	46.31
2012	365.97	425,804	64.36	163.32	632,390	46.59
2013	400.92	426,086	66.75	184.96	986,750	46.87
2014	422.29	425,184	67.00	198.82	1,004,234	47.14
2015	413.00	426884	67.20	216.12	1,094,950	47.14

Notes: GDP: Gross domestic product (current prices) (Billion US Dollar)

Freight: Road freight tonnage (1000 tones)

POP: Population (Total number of people living in a country/region in millions)

Source: GREATER MEKONG SUBREGION STATISTICS on Growth, Connectivity and Sustainable Development, Nay Pyi Taw, Myanmar, 20th Ministerial Conference, 10 SEPTEMBER 2015

Table 11 Statistic Data of Thailand-Yunnan Trade and Volume by Road (2006-2015)

Year	Thailand-Yunnan's Trade	Thailand-Yunnan's Volume by Road
2006	1.31	235,640
2007	2.2	230,751
2008	2.5	328,088
2009	2.3	381,258
2010	4.63	619,729
2011	7.4	764,060
2012	10.85	911,845

Table 11 (cont.)

Year	Thailand-Yunnan's Trade	Thailand-Yunnan's Volume by Road
2013	10.49	1.139.189
2014	10.73	1.531.529
2015	16.88	1.453.000

Notes: Trade: Thailand - Yunnan trade (current prices) (Hundred Million Us Dollar)

Volume: Cargo volume via Mohan Border Crossing (tones)

Source: Thailand-Yunnan Trade. collection from the Year Book of Yunnan. 2006-2015; Volume. collection from field visit.

For correlation degree analysis, here is the procedure based on Grey Model. Firstly, calculate the Y (Table 12) and P(j) in Table 13 as below.

Table 12 Correlation Analysis- Y

year	Volume	Y
2006	235640	1
2007	230751	0.979252249
2008	328088	1.392327279
2009	381258	1.617968087
2010	619729	2.629982176
2011	764060	3.242488542
2012	911845	3.86965286
2013	1139189	4.834446613
2014	1531529	6.499444067
2015	1453000	6.166185707

Table 13 Correlation Analysis -P

Year	P(GDP-Thai)	P(GDP-Yun)	P(Road Freight-Thai)	P(RF-Yun)
2006	1	1	1	1
2007	1.192621566	1.254298281	1.001267596	1.08121886
2008	1.316239316	1.637744902	0.992691443	0.645378955
2009	1.273407697	1.805677729	0.990869566	0.672534398
2010	1.539958472	2.133146741	0.983320119	0.753373808
2011	1.669177652	2.7514994	0.950785933	0.893951892
2012	1.767202666	3.265093962	0.995844062	1.043306827
2013	1.935969868	3.697720912	0.996503586	1.627924242
2014	2.039161717	3.974810076	0.994394045	1.656769063
2015	1.994301994	4.320671731	0.9983699	1.806430858

Year	P(POP-Thai)	P(POP-Yun)	P(Trade)
2006	1	1	1
2007	1.002459389	1.006915012	1.679389313
2008	1.004918793	1.013383895	1.908396947
2009	1.007378198	1.019629712	1.755725191
2010	1.009837587	1.026544725	3.534351145
2011	1.014473864	1.033013607	5.648854962
2012	1.018871129	1.039259424	8.282442748
2013	1.056781256	1.045505242	8.007633588
2014	1.060661377	1.051527995	8.190839695
2015	1.063827531	1.051505688	12.88549618

Secondly, calculate the difference between the reference sequence and the comparison of sequences as below:

Table 14 GA-Difference between Sequence and Comparison

Year	Delta (GDP-Yun)	Delta (Fr-Yun)	Delta (POP-Yun)
2006	0	0	0
2007	0.275046031	0.10196661	0.027662763
2008	0.245417623	0.74694832	0.378943384
2009	0.187709642	0.94543369	0.598338375
2010	0.496835435	1.87660837	1.603437452
2011	0.490989142	2.34853665	2.209474935
2012	0.604558898	2.82634603	2.830393436
2013	1.136725702	3.20652237	3.788941371
2014	2.524633991	4.842675	5.447916073
2015	1.845513976	4.35975485	5.114680019

Year	Delta (GDP-Thai)	Delta (Fr-Thai)	Delta (POP-Thai)	Delta(trade)
2006	0	0	0	0
2007	0.21336932	0.022015347	0.0232071	0.700137064
2008	0.07608796	0.399635836	0.3874085	0.516069668
2009	0.34456039	0.627098521	0.6105899	0.137757104
2010	1.0900237	1.646662057	1.6201446	0.904368969
2011	1.57331089	2.291702609	2.2280147	2.40636642
2012	2.10245019	2.873808798	2.8507817	4.412789888
2013	2.89847675	3.837943027	3.7776654	3.173186974
2014	4.46028235	5.505050023	5.4387827	1.691395627
2015	4.17188371	6.166185707	5.1023582	6.719310476

Thirdly, working for the correlation coefficient, that is,

Table 15 GA-Correlation Coefficient

Year	ε(DGP-Thai-Y)	ε(DGP-Yun-Y)	ε(Fr-Thai-Y)	ε(Fr-Yun-Y)
2006	1	1	1	1
2007	0.91267919	0.91267919	0.992065227	0.95959
2010	0.671695912	0.671695912	0.625689467	0.56337087
2011	0.586346597	0.586346597	0.545678193	0.50763132
2012	0.514736098	0.514736098	0.489221775	0.46141073
2013	0.434842527	0.434842527	0.417652433	0.43024126
2014	0.333333333	0.333333333	0.333333333	0.33333333
2015	0.348349345	0.348349345	0.347526082	0.3570719
Year	ε(POP-Yun-Y)	ε(POP-Thai-Y)		ε(trade-Y)
2006	1	1		1
2007	0.98994674	0.991538266		0.8275436
2008	0.8778745	0.875303043		0.8668456
2009	0.81990217	0.81663864		0.9606117
2010	0.62946824	0.626654874		0.7879072
2011	0.5521425	0.54966003		0.5826643
2012	0.49041874	0.488205897		0.432252
2013	0.41824046	0.418557428		0.5142716
2014	0.33333333	0.333333333		0.6651399
2015	0.34750399	0.347670472		0.3333333

Fourthly, below (Table 16) is the grey correlation of each parameter to the cargo volume. The table indicates that all parameters represent close relation with the cargo volume to the percentage of more than 60%. In particular, the road freight in Thailand has closer correlation to the volume, reaching to 1.57.

Table 16 Correlation Degree

	Thailand			Yunnan			Thailand Yunnan-
Parameters	GDP	Freight	POP	GDP	Freight	POP	Trade
Correlation	0.66	1.57	0.68	0.70	0.61	0.65	0.70

To be brief, from the analysis of the parameters—GDP, FDI, road freight tonnage in both Thailand and Yunnan, and trade value between Thailand and Yunnan, we can conclude as the following table shows (Table 17). For the independence among parameters, the correlation between DGP and FDI is presented first, which indicates that FDI occupies high percentage of GDP. In addition, The NSEC, however, are mainly the passage for vegetables and fruits in trade between Thailand and Yunnan, less involving in the trade of fruits and vegetables. So FDI is deleted from parameters for forecasting.

Then, further analyzing and selecting in remaining parameters has been undertaken through Grey Correlation Analysis. Such result indicates that the correlation degree between each parameter with the cargo volume. GDP in Yunnan has higher correlation of 0.70 than that of in Thailand (0.66); road freight tonnage in Thailand shows 1.57, while such figure in Yunnan is only 0.61; POP has some correlation with the transport volume, but data in both Thailand and Yunnan are less than 0.70, representing 0.68 and 0.65 respectively; and the trade value between Thailand and Yunnan shows the 0.70 in correlation degree.

So, among seven parameters, there are three showing the high percentage of correlation, namely, road freight tonnage in Thailand, GDP in Yunnan and trade value between Thailand and Yunnan.

Table 17 Summary of Correlation Degree Analysis

	Thailand				Yunnan				Thailand-Yunnan
Parameters	GDP	FDI	Fr.	POP	GDP	FDI	Fr.	POP	Trade Value
Analysis	0.66		1.57	0.68	0.70		0.61	0.65	0.70
Selected			×		×				×
Rejected	×	×		×		×	×	×	

Notes: Fr.= Road Freight Tonnage

Therefore, we can select those with more than 70% of correlation to set up the model as $y= A_2x_2+A_4x_4+A_7x_7$, then we take the previous data in year 2006 to 2015 into the model (H=0.8). With the EXCEL software, the fuzzy coefficients are concluded to be (0.000, 0.000), (3168.869, 0.000) and (58570.933, 84602.620) respectively. Such data means that the jth parameter x_j shows no correlation with y, when the first in A_j is 0.000. Thus we can conclude the predictive model as $y= A_4x_4+A_7x_7$.

2. **Model Result**

The result is shown in Table 18, with the comparison between the analogue value and true data (volume via Mohan Border Crossing (tones)) in Figure 12.

Table 18 Model Result (2006-2015)

Year	Predicative Volume	True Volume	Deviation
2006	235234.7358	235640.00	0.001719845
2007	327670.8764	230751.00	0.420019313
2008	406021.0584	328088.00	0.237537058
2009	420925.369	381258.00	0.104043375
2010	609301.7128	619729.00	0.016825559
2011	869556.3071	764060.00	0.138073328
2012	1153034.264	911845.00	0.264506867

Table 18 (cont.)

Year	Predicative Volume	True Volume	Deviation
2013	1200523.047	1139189.00	0.053840098
2014	1258500.591	1531529.00	0.178271785
2015	1673533.259	1453000.00	0.15177888

Source: Department of Commerce of Yunnan Province,
http://www.bofcom.gov.cn/bofcom/432926140726771712/20160518/398312.
html; Ministry of Commerce of People's Republic of China,
http://www.mofcom.gov.cn/article/resume/n/201509/20150901108031.shtml.
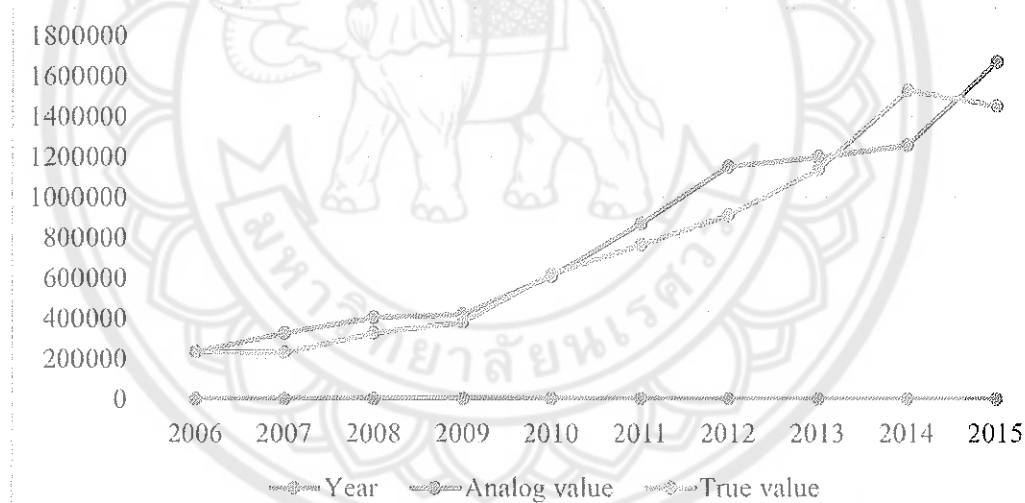Authors' Calculation.

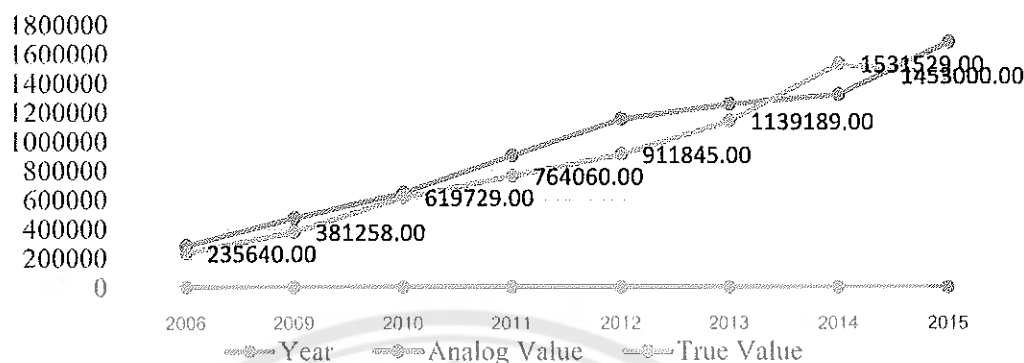**Figure 12 Comparison of Predictive and True Value (2006-2015)**

Figure 13 Comparison of Predictive and True Value (2006-2015)-Adjusted

Notes: Volume means cargo volume via Mohan Border Crossing (tones)

From both above graphs, the two maximum deviation occurs in the year of 2007 and 2014, reaching to about 42 percent and 43 percent, higher than the acceptable benchmark 30%. It is understandable that the year of 2007 witnessed the signs for the financial crisis erupted in 2008, in which economies with certain extent of reliance on the export-orientation would be detrimental and run in abnormal manners since the breakout of the crisis, and the year 2014 is the first year after the completion of NSEC in the end of the 2013. Thus, the data in the year of 2007 and 2014 can be deducted from the result as above two graphs. In addition, with the t-test as 0.148560805, we can conclude that the model is acceptable for the forecasting.

3. Predication of Freight

Therefore the above model indicates that the fuzzy liner regression model could be adopted for the prediction expected. So the first step is to estimate the two parameters so as to conduct the model for analog value of freight along NSEC.

4. Prediction of Parameters

In this paper, the predication of GDP in Yunnan and the trade value between Yunnan and Thailand could make access to the predication of freight volume along NSEC. The GDP growth rate in China has been adjust to about 6.7% by Chinese

government. While Yunnan's GDP growth rate is a little higher than that of the growth rate in China. so this paper will adopt 7% growth rate for forecasting of GDP in Yunnan. And 8% is to be adopted for forecasting the value of trade between Yunnan and Thailand. in accordance with the past data's trend (see Table 19).

Table 19 Forecasting Result of Parameters （2016-2025）

Year	GDP(Yun)	GDP(Prediction)	Trade	Trade ((Prediction)
2006	50.02		1.31	
2007	62.74		2.2	
2008	81.92		2.5	
2009	90.32		2.3	
2010	106.70		4.63	
2011	137.63		7.4	
2012	163.32		10.85	
2013	184.96		10.49	
2014	198.82		10.73	
2015	216.12		16.88	
2016		231.2484		18.2304
2017		247.4358		19.688832
2018		264.7563		21.26393856
2019		283.2892		22.96505364
2020		303.1195		24.80225794
2021		324.3378		26.78643857
2022		347.0415		28.92935366
2023		371.3344		31.24370195
2024		397.3278		33.74319811
2025		425.1408		36.44265395

Notes: GDP: Gross domestic product (current prices) (Billion US Dollar)

Trade: Trade between Thailand and Yunnan

Source: GDP. GREATER MEKONG SUBREGION STATISTICS on Growth, Connectivity and Sustainable Development. Nay Pyi Taw, Myanmar, 20th Ministerial Conference.10 SEPTEMBER 2015: Thailand-Yunnan Trade. authors collection from the Year Book of Yunnan. 2006-2015. Authors' Calculation.

5. Prediction of Freight along NSEC

With the parameters estimate in the future each individual calendar year, the forecasting of freight along NESC could be concluded in Table 20, based on the model set up in equation (3).

Table 20 Forecasting Result of Freight（2016-2025）

Year	Predicative Volume
2016	1800567
2017	1937285
2018	2084427
2019	2242791
2020	2413237
2021	2596691
2022	2794148
2023	3006683
2024	3235450
2025	3481695

Notes: Volume means cargo volume via Mohan Border Crossing (tones)

From the graphs below, the general trend of the analogue value is indicated. Except the data in the year of 2007 and 2008, the line shows a gradually increasing trend the nearly 2 decades, without too much fluctuation and obvious peak and bottom data. So the liner image from the diagram could be easily demonstrated, with the below chart (Figure 14) as a complementary information.
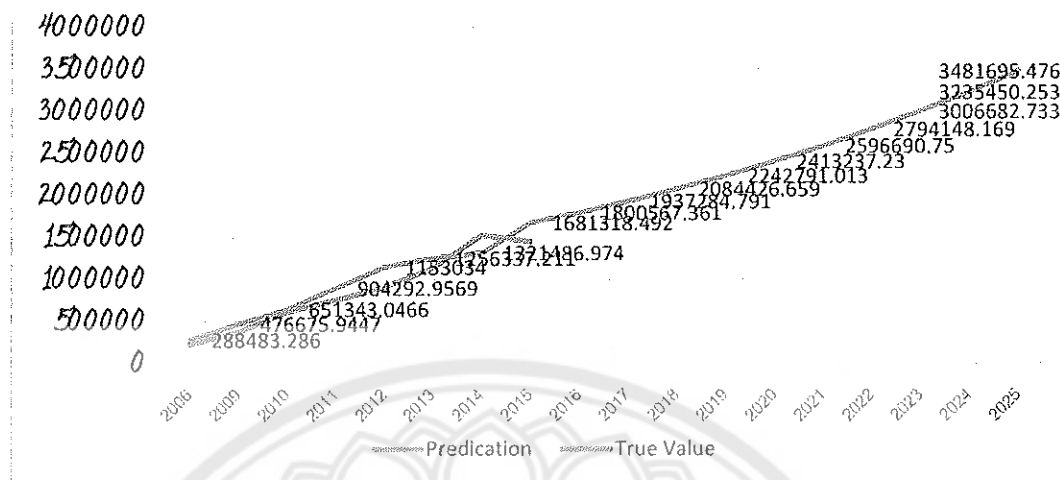
Figure 14 Forecasting Result-Liner Graph (2016-2025)

Note: Volume means cargo volume via Mohan Border Crossing (tones)

The general conclusion could be summarized as below. For the freight volume along NSEC, which comes mainly from the trade between Thailand and Yunnan province, PRC, parameters like GDP, POP, Road Freight Tonnage and the trade between Thailand and Yunnan have the close relation with the freight volume, but the correlation degree vary among them and is distinguishing between economies. GDP and POP in both Thailand and Yunnan relates with the freight to the similar level at approximately 64 percent to 69 percent, which indicate that the macroeconomic levels of economies are one of the driving forces of foreign trade, entailing the transnational logistics demand and more freight volume. For the better interdependence of the parameters, FDI is deleted from such variables due to its high correlation with GDP. And road freight tonnage, with the one in Thailand as the most obvious performance, contributes to the freight along this corridor. In particular, the trade between Thailand and Yunnan relates with the cargo to nearly 70 percentages, a good demonstration of the reliance of freight on trade demand. And for the degree of the correlation in terms of the individual economy, Thailand makes the contribution bigger than Yunnan does.

For the freight prediction, the fuzzy liner regression performs well with the deviation within 30 percent, based on data in 2006 to 2015. Considering the financial crisis in 2008, the authors remove the data in 2007 and 2008 for a general testing and

adjusting of the model. Further, the trend of each parameter is estimated in the following 10 years since 2016. Afterwards, such predicative parameters are developed into the fuzzy liner regression model and thus come to the conclusion of the forecasting of freight along NSEC. The total analogue value since 2006 to 2025 shows a gradually climbing up tendency, representing the slope into a liner manner. And the volume in 2025 would be about 1.26 times than the value in 2015 and 12.98 times than it in 2006.

Interview Analysis

   1. Interview's Statistics

        50 interviews are conducted as the below charts indicate, with the part 1 and Part II shown individually. In part I, all interviewee choose B (Far from efficiency) to evaluate the general logistics performance of NSEC and agree the less efficiency occurs in the section of Lao PDR, with one expert from ADB as the exception, who believe both Yunnan and Lao PDR are the parts with less satisfaction. The reasons for the less efficiency of Customs clearance (Figure 15), the most unacceptable charges (Figure 16), the reason(s) for the less efficiency or satisfaction of the transportation (Figure 17) and solutions (Figure 18) are shown below.

        The Figure 15 shows that all the listed reasons in the interview are related with the logistics performance along this corridor. In addition, the reason of complex procedures is deemed as the biggest adverse one, while the reason of too much documents is the least negative factor. Others are agreed by nearly 36 to 40 interviewees, 72%-80% participants.

Figure 15 Reasons for the Less Efficiency of Customs clearance along **NSEC**

Figure 16 indicates that both transshipment charge and informal charge at customs are regarded as the most unacceptable charge (96%), rather than the road transport freight (56%) instead.

Figure 16 Most Unacceptable Charges along NSEC

In general sense, the most majority of interviewee complain the whole logistics performance due to no sound management and lack of the unified logistics standards. Less frequently being blamed are no real-time tracing, language barrier, bad road condition and old facilitates and equipment at border crossing. Although the least

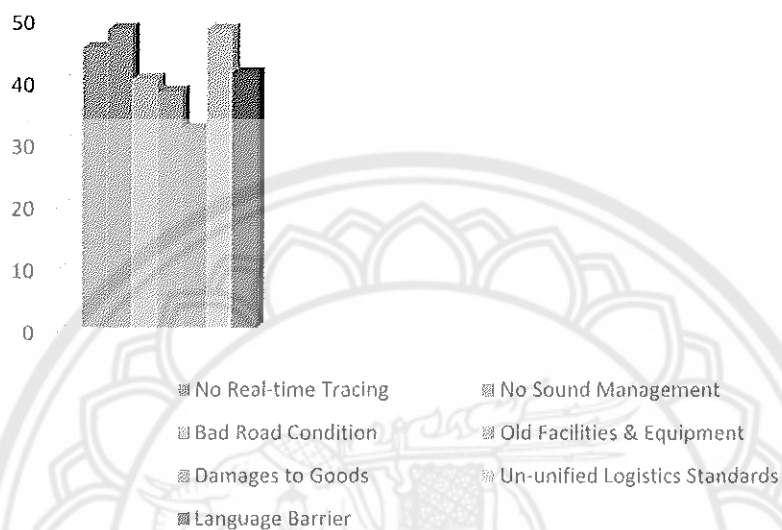worries is on damages to goods, the percentage is more than half of the interviewees, reaching to 64%.

Figure 17 Reason(s) for Less Efficiency/ Satisfaction of Transportation

Thus we can witness from the above chart to see the solutions suggested by interviewees. Without exception, they believe that for cross-border transportation, CBTA should be implemented fully and immediately in each member economy. The followed solution they propose is to reconsider a reasonable distribution of benefits for all members, in particular to Lao PDR, since it undertake as a bridge between Thailand and Yunnan Province, PRC in trade, in which the benefits from the trade is shared by trade partners, instead of the Lao, PDR, the contributing partner for the transportation of the trade in terms of all issues and maintenance for border-crossing. In addition, all other solutions are supported by most of interviewees, at least at 74%.

Legend:
- Simplifying Customs Procedures
- Implementation of CBTA
- Containerization
- Logistics Alliance / Association
- Improvement of Competency of Officals
- Reasonable Distribution of Benefits
- Sustinable Maintenance of Road
- Advanced IT Infrastructure

Figure 18 Solutions Suggested

At the end of Part I, every interviewee is asked "What is the key solution with the first priority in above mentioned items?" two interviewees cannot answer this question, since they believe there are a lot of solutions, rather than only one, need to be adopt without any delay. 33 interviewees choose "Simplifying the customs procedures", 14 for "Implementation of CBTA" and 1 choses "Improvement of competence of the local logistics industry". We can see that the majority support to make the customs clearance as simple and as soon as possible, which is the urgent practical need at this moment.

Part II aims to find potentials or expectation of NSEC form all interviewee. 32% participants agrees that the potentials of this corridor has been exploited, while the rest 68%, the majority hold that there will be about 70% of potentials to be developed in future days. However, they all believe that this corridor will be promising if the current barriers could be removed gradually. And the rest statistical results for the influencing factors of potentials (Figure 19) and how to exploit (Figure 20) are indicated below.
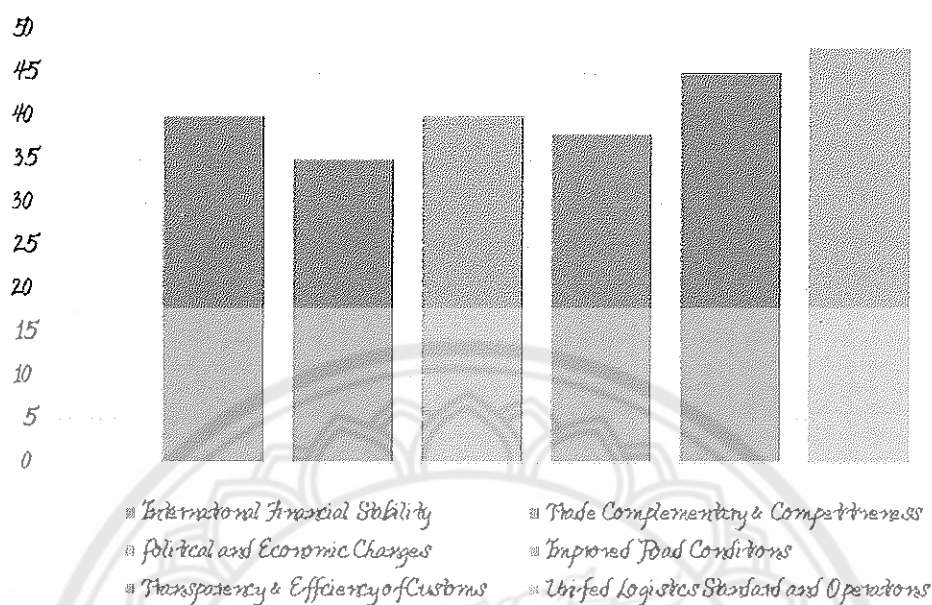
Figure 19 Influencing Factors of Potentials

In order to tap the existing potentials, 96% interviewees consider the unified logistics and operations is the positive influencing factor, except the GDP, population and road freight tonnage in both Thailand and Yunnan as well as their trade value. Followed elements supported by more than 70% interviewees are successively transparency and efficiency of customs (90%), stability of international financial, political and economic situations (80%), improved road conditions (76%) and the trade complementary and competitiveness (70%).

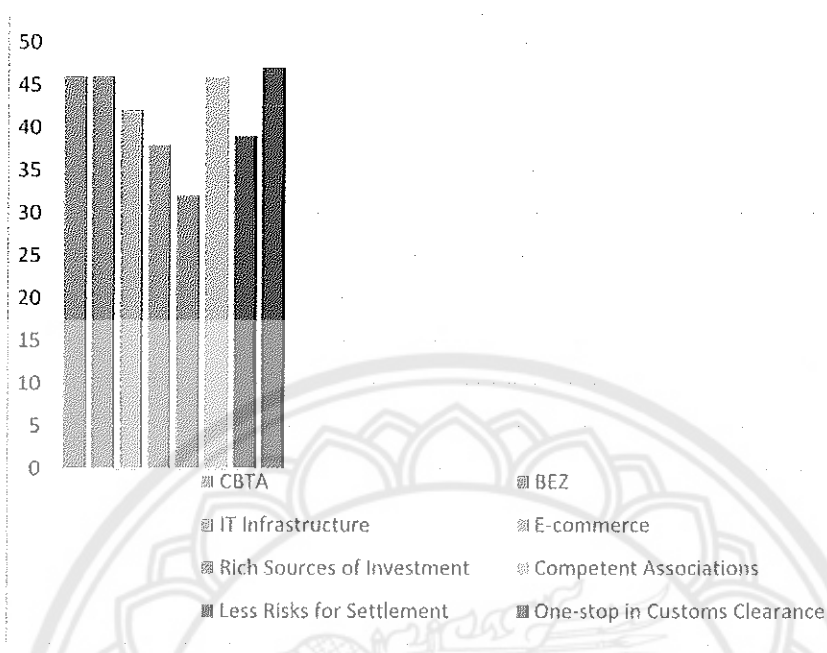**Figure 20 Suggestions to Tap the Potentials.**

How to tap the potentials along NSEC, 90% solutions tend to implement CBTA, establish Border Economic Zone (BEZ), set up a competent association to coordinate all participants involved and adopt one-stop service in customs clearance. What more than 70% interviewees propose, with the successive percentage, are improvement of IT infrastructure, less risk in trade settlement and trial of E-commerce.

Likewise, at the end of the interview, interviewees are asked "what is important but has been forgotten in this whole interview", three answers emphasize the standardization and unification of logistics facilities, technologies and infrastructures in both hardware and software perspectives. One expert from ADB suggests that businessman and customs should have direct and regular dialogue at all border crossings. And one expert from ADB strongly complain that China never let foreign trucks come in to China, which is totally unfair for other members, and Lao will fully implement the CBTA if they were given full access to Laem Chambang Port in Thailand. So if Thailand could compromise and Thailand and China implement the bilateral agreement under the CBTA, the whole logistics performance would be enhanced quickly and effectively.

2. Interview Result

As the above mentioned, results of the interview, a complementary approach to time-cost model for logistics performance and fuzzy linear regression for forecasting of freight along NSEC in quantitative perspective, could be concluded accordingly. All interviewee evaluate the general logistics performance of NSEC as far from efficiency and agree the less efficiency occurs in the section of Lao PDR, with one exception. On the one hand, in terms of the un-satisfaction in customs clearance, among negative factors, the software infrastructure is really what encumber the customs clearance. Regarding the whole cost for transportation, what makes all participants think un-reasonable is not cost in transport itself, but in the charges at border crossing for transshipment and customs clearance instead. And for the whole logistics performance, no sound management and lack of the unified logistics standards are being complained by majority of interviewees from the practical perspective. On the other hand, for exploiting the potentials along this corridor, due to the good relationship between Thailand and China in a comprehensive way, the origin of the transportation, the trade complementary and competitiveness is the least concern for interviewees. Thus they are optimistic about the future of this corridor and cares more about transparency and efficiency of customs, stability of international financial, political and economic situations and road conditions. In addition, solutions are in various aspects, all which may receive different concern with no distinguish diversities though. However, focus of solutions are put on the CBTA implementation with simplifying the customs procedures included at border crossing points, where governmental cooperation and coordination requires, competent logistics association in practice, IT infrastructure and E-commerce for incentive of further trade possibility.

Results of Methodology

From the combination and the result of the quantitative methodology and qualitative approach, the logistics performance and the potentials along NSEC are to be summarized here.

Regarding the logistics performance along NSEC, the main corridor for Kunming and Bangkok for exchange of perishable goods, results from UNESCAP Time/Cost Methodology and the interview can explain itself and each other. These two approaches indicate that this corridor is far from efficient, especially at the part in border

crossing points at Lao PDR. The former methodology focuses on the time and cost over distance, while the latter approach pays more attention to aspects rather than time and cost, but to cooperation and coordination among all parties involved in the whole logistics operations, which requires the hardware infrastructure at the beginning and afterwards, much more how to cooperate and coordinate, the software infrastructure to support the effectiveness of the road, facilities and equipment for logistics operation. So what makes this corridor far from efficiency and hard to further to be tapped is in both hardware and software infrastructure, with the latter one as the focus and priority at this moment. Therefore, how to support the sustainable, stable and smooth development for the efficiency of this corridor turns to be what is to be studied in the following sections of this thesis. In particular, the implementation of CBTA, the efficient and effective customs clearance at points of border crossing, the successive investment and maintenance of road in Lao PDR, the benefits of Lao PDR and improvement of facilities and working efficiency of all parties need to be studied below.

About the potentials of NSEC, based on the past ten years (2006-2015), in which 2013 witnessed the completion of NSEC, the freight volume represents a general steady increasing trend except two years 2007 and 2008, when the financial crisis erupted. In particular, the volume in 2014 is about 6.5 times than that of in 2006. Such fact certifies that the construction of physical infrastructure is a pre-condition to attract trade between Thailand and Yunnan. However, as the data shows, the hardware infrastructure inspire trade between Thailand and Yunnan in perishable cargoes though, the trade volume does not experience too much growth as expected. This is why this corridor is not a real sense of economic corridor, but a transport corridor instead (as defined in Footnote 17). In addition, as fuzzy linear regression model implies, the freight volume along this corridor is closely related with the trade value between Thailand and Yunnan province and the GDP of Yunnan. The predication shows that the freight in 2016 could to be the 2.17 times than that of in 2014, which shows the optimistic about the future potentials along this corridor. Thus, if solutions could be found and implemented effectively, NSEC would attract more freight volume than predicted, namely, the trade between Thailand and Yunnan would grow up with higher rate. Likewise, how to encourage more trade and facilitate it and lower the risk of trade is what to be studied in following section.

CHAPTER V

MAIN OBSTACLES AND CUNTERMEASURES

This chapter, based on the general result from the last chapter, is to find out obstacles hindering the efficient logistics performance along NSEC and then propose solutions to such inefficiency and overcoming the deficiency or improving its efficiency in more specific perspectives. And a general notion for this chapter is, only through improving the logistics performance to efficient transport connectivity (ETC) along this corridor could its potentials be inspired and its economic sense be implemented.

Main Obstacles

1. Implementation of CBTA

The GMS Cross Border Transport Agreement (CBTA) originates from a basic requirement of transiting of goods over boundary of a foreign economy under a bilateral (as defined in Footnote 18) or multilateral agreement. Imposing transshipment of traded goods at the border (See Figure 21) has been a continuous source of problems, wasted time and added costs. Such situation led GMS authorities, inspired by the European-designed TIR (Transports International Routers), to design a general transport facilitation agreement which could cover all aspects of border crossing for goods and passengers and be agreed by all participants.

From the trilateral transport agreement between Thailand, Lao PDR and Vietnam signed in 1999 without the annexes and protocols, to the main text signed by 2003 all GMS member states had signed the main text, negotiations on Annexes and Protocols between 2003 and 2005, all members had signed the by 2007 and began to ratify. All members, except Thailand and Myanmar, who still ratified some Annexes and Protocols, had ratified CBTA with Annexes and Protocols by 2010. It was only in November 2015 that CBTA could claim to have been fully ratified, including Annexes and Protocols, by all GMS member states.
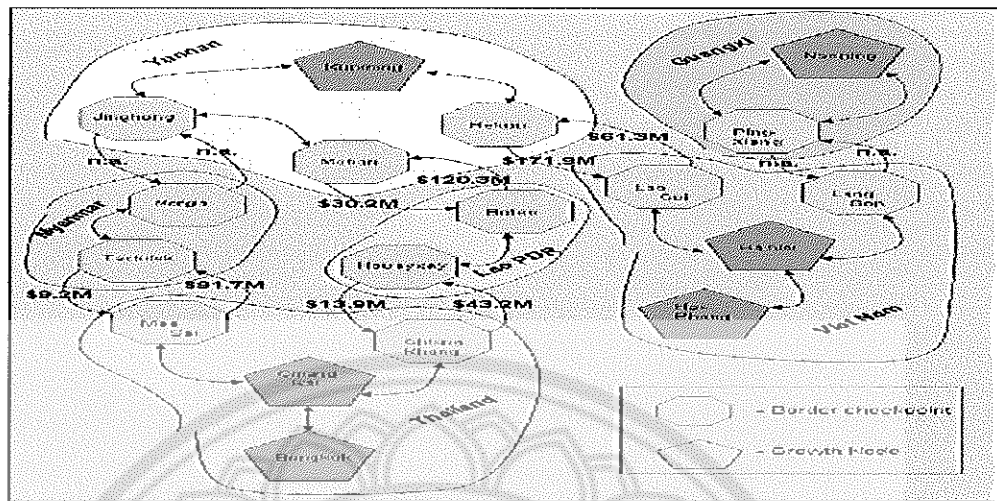
Figure 21 GMS Border Points

Source: ADB, 2013

Except the time-consuming proceedings in ratification by parts and then by all members, the implementation thereafter also experiences a process with much more difficulties in many aspects. For one thing, despite the implementation of a few CBTA article, trade movements continued to be regulated through existing bilateral agreements, although the first implementation along the EWEC corridor and among the three first original signatories (Thailand, Lao PDR and Vietnam) could be reached before full ratification. Later, the full implementation had been conducted at Dansavan/Lao Bao between Laos and Vietnam and then at Hekou/Lao Cai and Mukdahan/Savannakhet, where Single window inspection (SSI) was quickly implemented but single stop inspection (STI) was only implemented in 2015. These measures are important but they do not qualify for full implementation. For another, when it comes to implementing CBTA, practical difficulties and inconsistency occurred. Such limitations could be found in different technical standard specifications of vehicles, temporary import permit supported by security guarantees from carriers and trailers (when applied), the issuance of temporary permits, the need to get proper transit guarantees in foreign territory and empty back-haul as well. Further, seriously problem relies on the practicality of the transit guarantee for goods. The choice of the guarantor, a guarantee association remains

obscure. The amount of guarantee required (SDR 70.000) is high and in relation to the risk involved (low prevailing tariff). The non-transferability of the guarantee from one Customs service to another and the need to replenish the guarantee impose a serious financial burden on the guarantor (ADB, 2016). What's more, the "Customs Transit System" (CTS), the key component of CBTA, is perceived as complex, not easy to implement and yet to be tested. Thus, all these expose the CBTA to be weak support to cross border transportation and trade, which go far from what all members set forth for the CBTA (as defined in Footnote 19), although In addition, the CBTA, as a multilateral agreement, nevertheless, is a guideline or a framework, not a biding legal commitments. A detailed analysis of the content of the GMS CBTA is given in the table below (Table 21).

Table 21 Analysis of GMS CBTA Content

Items	Specific Theme	Content
Crew	Visa	Host Country to issue for drivers of carriers multiple entries visa valid for one year (Article 5 and Annex 5)
	Driving License	Drivers should have a valid driving license with certified English translation if needed issued by Home country or Contracting country. There will be mutual recognition of driving licenses issued by Competent authorities (Article 17 amended and Annex 16).
Reciprocity	Reciprocal Recognition	Vehicles involved in international transportation should have been properly registered in their home country (Article 12 and Annex 2.2) and registration certificate and vehicle inspection certificate (not mentioned as mandatory) should be recognized by Host country (Article 14 and Annex 2.8).
	3rd party insurance	Transport Operators must carry relevant insurance covering its liability (Annex 9.6) and 3rd party insurance for all vehicles crossing borders (article 16)

Table 21 (cont.)

Items	Specific Theme	Content
Right of transport in Host country	Free movement	Each Contracting Party shall grant temporary admission to its territory of motor vehicles registered in the other Contracting Parties, without payment of import duties and taxes and free of other prohibitions and restrictions (Annex 8.2); Vehicles must carry a temporary admission document issued by Home Country authority (Annex 8.3); Temporary admission should be valid for a 3 months period but vehicle should exit within 30 days (Annex 8).
	Transport Operators	Transport Operators should meet certain conditions to be verified by Home country: not being sanctioned, reliable with professional competence, financially solvable and with liability insurance (Annex 9.4.5,6)
	Permits and Quotas	Transport operators of one Contracting Party shall be entitled to perform cross-border transport operations only if they hold a GMS road transport permit (Protocol 3.1). Permits should be issued by the Home Transport Facilitation Committee with a suggested maximum of 500 permits for freight operation. Permits should be valid for 1 year, with multiple entries. Authorized vehicles should be listed in the permit and only one permit per vehicle (Protocol 3.4.5.6).
	Routes	Corridors, allowed routes and points of entry and exits are specified in Protocol 1.
	Security Bonds	In order to cover import duties, Home authorized authority may make payments in different forms (bank account in Host Country, cash deposit, or bonds). In the case of security bond, the maximum should be SDR 40,000 (Annex 8.11).

Table 21 (cont.)

Items	Specific Theme	Content
Transit Conditions	Right to transit	Along resolution 48/11 of ESCAP. Article 8 and Annex 6.1, right to transit is given provided that operator can show a "Transit and Inland Customs Document" in order:
	Exemptions	Transit cargoes carried across borders shall as a general rule be exempted from routine physical customs inspection en route, customs escorts in the national territory, and the payment of customs duties (Article 7 and Annex 6.2).
	Transit Charges	There are only a limited number of permissible charges: tolls, overloading charges, taxes on fuel purchased only, charges on used services, road maintenance charge (Protocol 2.6, 7).
	Security Bond	Transporters may pay for its monetary obligations to the Host country in different forms (bank account in Host country, cash deposit or bond). In the case of security bond, the maximum should be SDR 70,000 (Annex 6.11).
Cargo	Special conditions for some cargo	Contracting parties may allow transport on their territory of dangerous goods with permission on a case by case provided that it is carried along UN Convention of 1957 (Annex 1.1,2,3 and 4). Perishable goods should receive priority at BCP but should be handle along very defined rules (Annex 3)
	Cargo document	Each cargo carrier should present at BCP a consignment note with standard format described in Annex 10. Annex 10 also contains specific instructions on pricing of transport and dealing with losses and delays.
	Cabotage	Cabotage is normally not permitted unless special permission are given (Article 19)
	Containers	Containers entering the Host Country should have a temporary admission document (Annex 14.5) with a validity period of 6 months; containers must exit within 30 days (Annex 14.8). Security bond per container is fixed at SDR 600 (Annex 14.12).

Table 21 (cont.)

Items	Specific Theme	Content
Standards	Vehicle standards	Weights, axle loads, and dimensions must comply with the technical standards of the Host Country.
	Infrastructure standards	Road and bridge design should follow the Asian Highway Standards as defined by UNESCAP 1995 (Article 25 and Annex 11).
Harmonization	Harmonization of BCP Management	Provisions of minimum standards for passenger and freight operations are defined in Annex 12. Coordination in BCP hours of opening (Annex 4.3).
	Harmonization of Customs Procedures	Contracting parties pledge to reduce number of documents for border crossing, introduce Single Window and Single inspection system (Article 4 and Annex 4,5,6, 7 and 8). Use of the classification of goods under the Harmonized System (HS) is mandatory (Annex 15).
	Harmonization of Customs Procedures	Contracting parties pledge to reduce number of documents for border crossing, introduce Single Window and Single inspection system (Article 4 and Annex 4,5,6, 7 and 8). Use of the classification of goods under the Harmonized System (HS) is mandatory (Annex 15).
Institutions	National coordinating body	Each Contracting Party would establish a National Transportation Facilitation Committee (NTFC) with participation of all the relevant departments and private sector. The NTFC (or the authorized Competent Authority) is responsible to issue GMS Road Transport Permits (Protocol 3.5).
	Joint Committee	NTFC from Home and Host(s) countries will together form the Joint Committee (JC). JC would be responsible to resolve dispute and monitor good functioning of border crossing activities (pricing, infrastructure...).

Table 21 (cont.)

Items	Specific Theme	Content
	Authorized organization or institution issuing guarantee	The authorized organization of the Home country responsible to issue the transport and transit security guarantee (or bond) should have assets in the Host country.
	GMS	Any amendments or proposed changes by Contracting Parties should be submitted to the GMS Joint Committee (for instance Protocol 1.3, and Protocol 2.9 and 3.9).

Source: ADB, 2016

Under such circumstances, members of GMS tend to rely on bilateral agreements (See Table 22) and even cementing new ones. The main features of the transport agreements that were signed among NSEC member states are summarized below. And these agreements are in general in conformity with WTO, however, they are not comply with the "simplification of customs procedures" or the Perishable Goods Annex and the treatment of transportation of live animals in hygienic and "minimum suffering" manners.

With all above diverse elements considered, it is understandable why the CBTA evolves to be a bauble, instead of an umbrella for all GMS members. So as it is reported by the World Bank the LPI, compared with the performance in Singapore, there is not big progress since 2007 to 2016 (See Table 23), when CBTA experienced its preparation, partial signing by some members to full text's signing and then to the ratification as well as to the implementation.

Table 22 Main Features of GMS Bilateral Agreements

Agreement	Date of signing	Relation with other agreements	Main features
PRC – Lao PDR Bilateral Agreement	12/03/1993	Drafted and in force before CBTA	PRC trucks can drive in Lao PDR without restrictions but Lao trucks can only go to Mohan. On 7/03/2013, they agreed to increase permit quotas by 50% for buses (to 20,000) and 25% for trucks (to 20,000)
Lao PDR – Thailand Bilateral Agreement	05/03/1999	Replace 1/06/1978 agreement	Agreement give rights of entry to passengers and trucks without quotas and without limitations on routes or other conditions
Lao PDR – Thailand Bilateral Agreement	17/08/2001	Subsidiary Agreement to 1999	Agreement give rights of entry to passengers and trucks without quotas but define routes and BCPs; vehicles should follow technical standards set up by ASEAN;
Thailand – Lao PDR – Vietnam Trilateral Agreement	17/08/2001	Subsidiary Agreement to 1999	Agreement give rights of entry to passengers and trucks without quotas but define routes and BCPs; vehicles should follow technical standards set up by ASEAN;
Thailand – Lao PDR – PRC Trilateral Agreement	26/11/1999	"father" of the CBTA	Contains all the provisions of CBTA; temporary admission permits; conditions for transport operators; guarantees for carriers and semi-trailers; guarantee for transit goods max SDR 70,000 ($50,000).
Thailand – Lao PDR – PRC Trilateral Agreement	Not signed	CBTA	Issue permits scaled per year 100/200/300/500; vehicle tech spec according to host country; security guarantee defined in separate document; along north south corridor Mohan-Boten-Houayxay-Chiang Khong.

Source: ADB. 2016

Table 23 Logistics Performance Index (LPI) (2007-2016)

	Thailand	Lao PDR	China	Singapore
Overall LPI -Score				
2007	3.31	2.25	3.32	4.19
2010	3.29	2.46	3.49	4.09
2012	3.18	2.3	3.52	4.13
2014	3.43	2.39	3.53	4
2016	3.25	2.05	3.66	4.15
Overall LPI -Rank				
2007	31	117	30	1
2010	35	118	27	2
2012	38	109	26	1
2014	35	131	28	5
2016	45	152	27	5
Quality Logistics-Score				
2007	3.31	2.19	3.4	4.21
2010	3.16	2.14	3.49	4.12
2012	2.98	2.44	3.47	4.07
2014	3.21	2.31	3.46	3.97
2016	3.14	2.1	3.62	4.09
Quality Logistics-Rank				
2007	29	106	27	2
2010	39	137	29	6
2012	49	104	28	6
2014	42	149	35	8
2016	49	144	27	5

Notes: The LPI classified the degree of logistics friendliness score in the following way: < 2.5: Logistics unfriendly. 2.5 – 3.0: Partial performer. 3.0-3.5: Consistent performer, > 3.5: Logistics friendly. PRC and Thailand score relatively well in the LPI. while Cambodia. Lao PDR and Myanmar should be considered as 'logistics unfriendly'' and problematic.

Source: World Bank LPI 2007-2016

2. Border Crossing Operation

As indicated through time and cost over distance graphs as well as interview result in Chapter four, the biggest and first challenge of efficient transportation along NSEC relies on the part at border crossing. Reducing cross-border trade costs thus constitute as one of the priorities of the NSEC due to its complicated customs procedures, weak supporting policy frameworks as well as weak proficiency human and institutional capacities. As another example, it should be pointed out that customs laws in Lao PDR and Myanmar require that all goods must be cleared at entry points, the causes of general congestion. The problem is aggravated by the practice of restrictive "hours of opening" of Customs offices at BCP, being generally from 8 am to 5 pm, 5 days a week and with lunch breaks. Further, the absence of customs bonded houses add to the difficulty. The price distortion as a result of unofficial payments also leads to the current high logistics cost.

Transshipment is another key aspects for putting the cost at borders higher. Transshipment of cargo is common in Huayxay, Boten, and Mohan, with Boten being the most important transshipment point (because Thai and PRC trucks can both enter Lao PDR). Thai-PRC trade is mainly transferred in Boten and Huayxay whereas Lao-PRC trade is mainly transferred in Mohan. The facilities in Boten have not improved much over the past five years and transshipment is still done using manual labor (as opposed to container swaps). The manual transshipment process poses a significant risk for cargo damages.

In addition, prospective carriers would need to go through many steps to obtain the required documents to get entry into the host country and the mechanism of issuance of the security guarantees has not been tested. Carriers would need to have temporary permit attached to a bond guarantee. Drivers should carry the following documents:

1. Passport with visa;
2. Vehicle registration and recent vehicle inspection certificate;
3. Third party insurance;
4. Consignment Note;
5. Temporary Admission Document;
6. Transit and Inland Customs Document (if transit);

7. GMS Transport Permit;

8. Provisions for payments of import duties and other charges;

9. Security bonds for the temporary import of vehicle, goods in transit and container.

It has also been noted that, despite large volumes of fruits and vegetables being transported along the NSEC, there are no cold chain facilities: transshipment is taking place in an open, unhygienic environment. Damage and spoilage of cargo is 1-5 percent, according to a 2012 study (Ksoll, & Quarmby, 2012). Since the trilateral agreement between Thailand, Lao PDR, and PRC has not yet been enacted, all cargo will continue to be transshipped at the border. This regulatory barrier offers the opportunity for Lao PDR to provide value-added services to the fruit trade such as sorting, grading, packaging, etc. In addition, a clean, refrigerated transshipment space could help improve the quality of the supply chain, thereby increasing product quality and extending shelf life.

At the same time, there are some others participants who could hamper the efficiency of this NSEC. It is common to see the corruption and informal payments, resulting in an unreasonably high transport cost and thereby impeding new entrants into the market. Also there is a continuous trend of resistance of CBTA in practice. In addition, although Lao PDR receives the financial aid from neighboring economies to alleviate infrastructure investment and maintenance cost, however, the fees charged by Lao PDR logistics providers remains high and the separate inspection of people and goods with differentiated speeds keeps complex and time-consuming.

Said from another way, it is reported by World Bank in The Doing Business Index with one particular component on the question of "trading across borders". The overall index and results on this last component are given in the Table 24. Cambodia, Lao PDR, and Myanmar rank badly on the overall Doing Business Index, doing slightly better when considering the trading across borders component. The most striking features have been highlighted in the table. It takes only 4 hours in Singapore to prepare the documents for exports but 216 hours in Lao PDR and 144 hours in Myanmar.

One more perspective to understand the logistics performance at borders is the logistics restrictiveness index prevailing among the ASEAN member states. The index for GMS countries in ASEAN and Singapore for comparison is given below.

As an example. customs laws in Lao PDR and Myanmar require that all goods must be cleared at entry points. the causes of general congestion. The problem is aggravated by the practice of restrictive "hours of opening" of Customs offices at BCP. being generally from 8 am to 5 pm. 5 days a week and with lunch breaks. Further. the absence of customs bonded houses add to the difficulty (see Table 25).

Table 24 Doing Business Indicators (Rank and trading across borders, 2016)

Country	Overall Rank	Trade BCP Rank	Time to Export			Cost to Export			Time to Import			Cost to Import		
			Doc	BCP	Transport	Doc	BCP	Transport	Doc	BCP	Transport	Doc	BCP	Transport
China	84	96	21	26	7	85	522	306	66	92	7	171	777	320
Lao PDR	134	108	216	3	2	235	73	150	216	5	2	115	367	200
Thailand	49	56	11	51	2	97	223	147	4	50	2	43	233	147

Source: World Bank. 2016

Table 25 Restrictiveness Index ASEAN (2008-2013)

	Thailand	Lao PDR	Singapore
Total Logistics Restrictiveness Index			
2008	0.55	0.49	0.1
2013	0.52	0.54	0.12
Customs Restrictiveness Index			
2008	0.43	0.51	0.1
2013	0.38	0.42	0.04
Road Restrictiveness Index			
2008	1		
2013	1	0.5	

Notes: 0 no restrictions and 1 very restrictions

Source: Marn Meong Wong. & Claire H. Holweg. 2015

Therefore, due to the complicated operations in border crossing points, as indicated in the interview in last chapter, irrational time and cost over distance at borders comes from, in the artificial and practical layer, transshipment as the core, requirements to obtain the required documents to get entry into the host country and the mechanism of issuance of the security guarantees, corruption and informal payments, and on earth comes from the shortage of supporting policy frameworks as well as human and institutional capacities, which is the natural result of non-compliance with the CBTA.

3. Benefit Distribution

Except the institutional hindrance discussed, what need to be considered is the reason why such obstacles occur mainly and seriously in Lao PDR. A general concern is if Lao PDR could be beneficiary from the transshipment or transport via border crossing operation to the extent, which is demonstrated in either micro or macro perspectives. Lao PDR might be more willing to participate or participate with more enthusiasm, therefore, improve the efficiency transport more easily and smoothly. However, this corridor is one of the main passages by road for Thailand and Yunnan in transporting vegetables and fruits with the Lao PDR as the linking bridge to connect. Thus the beneficiaries along NSEC are Thailand and Yunnan province in exchange of traded goods. Under such circumstances, the benefits or the positive influences in Lao PDR constitute a crucial impetus for or detriment to the sustainable operation of the transshipment in Lao PDR.

3.1 Benefits in Lao PDR

The unsatisfied logistics performance along NSEC comes from a critical and potential issue-the unbalanced sharing of costs and benefits among members. The NSEC is designed for promoting mobilization of trade, investment, and passenger traffic between Thailand and Yunnan Province in particular and entailing positive socioeconomic impacts along the route. Thus it is understandable and reasonable that all the participants can expect benefits, either economic or political, in macro or micro perspectives, in the involvement of this corridor. Further, the benefits they can share through cooperation would be higher than they would be if the projects were undertaken by the individual countries in a separate manner. This can arise for road projects, for example, where cross-border trade facilitation that accompanies the construction of a road on both sides of the border allows a higher growth of trade and thus traffic.

For Lao PDR in particular, the part of NSEC (two-lane highway of 228-kilometers) covers from Houay Xay in Bokeo Province to Boten in Loung Namtha Province so that Lao PDR could expect road charges for vehicles and passengers, business opportunities there, external markets to promote the development of commercial agriculture and lower cost of goods delivered in.

From the survey and research of ADB (2014), some social-economic indicators such as income and expenditure, employment opportunities, livelihood indicators, asset and livestock ownership, time to access various services, service access or usage are presented (See Appendix B). The appendix indicates that living standards over the last 5 years have been improved through doubled income per capita (67% more on average) and lowered levels of poverty (8 percentage points lower) as well as significant more usage of various services in banking and selling rice in a market, however, residents here still considered farming as their main occupation. So we can conclude that significant positive change have occurred in Houay Xay and Boten, but it is undeniable that road maintenance's cost, infrastructure investment, and social and environmental impacts to the transit economy still suspended.

3.2 Benefits in Yunnan

At the same project, ADB (2014) studied the T the border counties of Mengla and Funing, where no differential impact relative to the domestic connectivity has been found. This may occur if the road improvement has not been witnessed as the case in Lao PDR or the CBTA has not been implemented. And to some extent, the part of NSEC in Yunnan has been connected highly with the dynamic domestic market in the rest of the PRC (See Appendix C).

3.3 Benefits in Thailand

The research conducted by ADB covers paved two-lane highway from an unpaved seasonal road with only a single lane along some stretches. Also newly constructed bridges, widened existing bridges and the upgraded ferry facilities across the Mekong River as well as a new bypass around the town of Louang Namtha can facilitate the transportation system there. The result indicates only a modest impact in higher agricultural investment and higher financial savings in urban areas, however, there were no obvious influence in income, which was expected in more import and export due to road improvements (See Appendix D).

While, as demonstrated in the table of comparison of transport mode (Table 22), Thailand can exploit the benefit on R3 routes along the NSEC, where fresh fruit from plantation to Kunming, Sichuan and Chongqing, Takes only 3 days, leaving 7 days to distribute the goods in China. But, the transport by sea freight cost about 8-10 days so that days for distribution are limited in few days. So from such concern, the logistics performance in cost and time have been greatly enhanced in R3 along the corridor.

To be brief, Lao PDR has enjoyed some benefits in micro and macro ways though, there are still a big unbalance, provided we consider benefits from the trade and potential connectivity for both Thailand and Yunnan at present and in the future. Also, in practice, regulations or operations may lag PDR from enjoying the goodness from acting as a bridge between Thailand and Yunnan. So in a general sense, taken other factors into accounts, such as the environmental issues, smuggling, and security concerns, the adverse effects carry more weight than the positive influences for Lao PDR.

4. National Infrastructures

Road condition is one of the factors being complained as the adverse elements for efficient transport along NSEC. The NSEC has been upgraded in Thailand, Lao PDR, and PRC's Yunnan Province with the assistance of Thailand, PRC, and ADB (see Table 26). Upgrade of the whole road was completed in 2008. The 4th Thailand-Lao Friendship Bridge, linking Chiang Kong and Huayxay, has been constructed at a cost of THB 1.48 billion (~USD 48 million) and opened in December 2013. The construction was funded by the PRC and Thailand. The opening of the bridge replaced the ferry service, a major constraint for high-value and sensitive cargo that contributed to congestion during peak times.

Table 26 Development of NSEC Roads

| Route and/or Section	Status	Remarks
Kunming–Yuxi (91 km)	Upgraded to 6-lane expressway	
Yuxi–Yuanjing (112 km)	Upgraded to 4-lane expressway	
Yuanjing–Mohel(147 km)	Upgraded to 4-lane expressway	
Mohel–Pu'er (71 km)	Upgraded to a 65 km expressway	
Pu'er–Xiaomengyang (98 km)	Upgraded to expressway	Originally in class 3 and 4 road
Xiaomengyang–Mohan (217 km)	upgraded from class 4 to class 2; reconstructed road to be 175 km	Upgrading or reconstruction from 2004 to 2008.
Boten–Houayxay	Section funded by the PRC (67 km) completed in June 2006; section funded by ADB (77 km); section funded by Thailand's Neighboring Countries Economic Development Cooperation Agency.	Whole road the Lao PDR completed in 2007
Houayxay–Chiang Khong Chiang Khong–Chiang Rai (110 km)	Constructed a bridge on the Mekong upgraded two-lane highway to be to 4 lanes	Completion in 2013. Within 2009–2012.
Chiang Rai–Bangkok (830 km)	Upgrade to at least 4-lane standard	

Source: ADB, 2016; and the author's alteration

    The road infrastructure in Thailand and PRC is in very good condition with no missing links. On the Thai side, a 30 km gap between Chiang Rai and Chiang Kong was closed in 2012 with the opening of a 4-lane highway, where has an effective paved road network with important corridors. While in PRC and Lao PDR it has 2-lanes (with some exceptions). Much improvement has been witnessed the road network in the Lao PDR though, average speeds, however, in Lao drop to 20-60 km/h, compared to 80-100 km/h in PRC and Thailand, partly because of the mountainous terrain, winding road, and road condition's deteriorating during the rainy season and due to truck's overloading, causing long and deep lane grooves. So it is no doubt that these negative

elements may ascribe to the inefficiency of transport along border crossing.

Another perspective of Infrastructure scores of the Global Competitiveness Report could make such conclusion further to be explained. Over the past two decades, GMS countries have invested billions of USD in road infrastructure development, some with the assistance of development partners. Infrastructure conditions have improved significantly compared to 1998, the start of the GMS corridor initiative. The progress in infrastructure is mirrored in the Global Competitiveness Report, where all countries made good progress over the past decade (see Figure 22). The two leading economies in the GMS are the PRC and Thailand. Thailand's and PRC's improvements extend not only to economic corridors but throughout the whole road network.

The corridor concept is less relevant for transport operators in Thailand and the PRC. The denser road networks in those countries (as compared to the other GMS countries) let domestic transporters choose their preferred route (quickest, shortest, cheapest, most reliable, etc.) rather than basing it on designated corridors. For foreign operators, corridors are still relevant because bilateral agreements or the Cross-Border Transport Agreement (CBTA) put restrictions on what routes they can take.
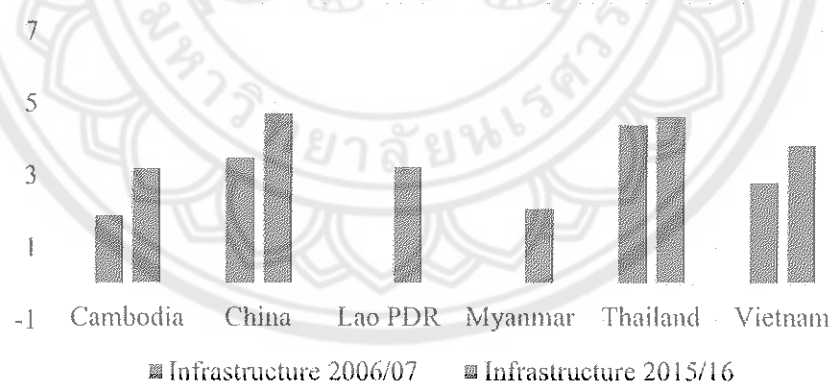
Figure 22 Infrastructure Scores of the Global Competitiveness Report 2006/07 vs. 2015/16

Notes: Scale from 0 (worst) to 7 (best); missing data for Lao PDR and Myanmar in 2006 and 2007.

Source: World Economic Forum, 2006; World Economic Forum, 2015

5. Others

Other barriers come from the informal one. Informal barriers is defined as unwritten rules and regulations guided by a set of practices and norms, which are recognized and conducted universally by local social and economic actors (Roman Vakulchuk, & Farrukh Irnazarov, 2014), as the Figure 6 shows.

5.1 Logistics Association

Respondents in the interview point out that the lack of effective associations, is a serious impediment to the efficient transport along NSEC. These associations could unit companies in the same or similar industries for establishing business relationship domestic and foreign, and collecting information about foreign markets in supply and demand. And most importantly, associations could act as a bridge between companies and the members of governments to coordinate the contradiction between practices and regulations of CBTA and bilateral agreements at this moment, when CBTA has been ratified by all members but suspended, which would unite companies domestically and establish contacts with associations from the same industry in other countries.

However, the non-competitive and self-centered, protectionist behavior by LLG (Lao Logistics Group) would be detrimental to logistics efficient connectivity and push trade costs higher. LLG, established in 2015 among a series of investors, transport operators and freight forwarders, consisting of the 10 major logistics operators, aims to offer a consolidated private sector view on logistics in Lao PDR as well as to increase the knowledge and capacity in Laos of logistics through training. Thus it is expected to be a lobby group to the Government. There are, however, detrimental policies, like taking a stand in keeping and even increasing transshipments at the borders to protect the Lao trucking industry. This protectionist attitude comes from the perception that a liberal opening of the border with Thailand would result in a takeover of the trade transport in Lao PDR by Thai operators, which have far larger, more modern and efficient fuel vehicle fleets with lower cost than Lao operators. Further, there is also a risk that group like LLG be tempted to adopt cartel measures pushing the transport charges up.

5.2 Contradictions of policies and regulations

The 1999 Lao PDR- Thailand Bilateral Transport Agreement gives the right to Lao trucks to drive in the Thai territory without route restrictions. Also there was no quota imposed. However since the enforcement of the agreement Lao trucks have been forbidden to enter LaemChabang Port (LCB). LCB is the key port for Lao exports and imports. This restriction goes again the principles of CBTA and ASEAN Agreement for Goods in Transit, as the official from ADB indicates in the interview.

Operators carrying transit cargo through Thailand to Lao PDR must purchase a security guarantee or bond. This applies to the value of the cargo and is intended to cover taxes and duties if cargo fails to exit Thailand. According to Thai Customs law, the value of the guarantee is fixed at 1million Baht for Lao cargo and 2 million Baht for other country cargo. The guarantee can only be issued by a Thai Bank or a foreign bank with branches in Thailand. Only authorized economic operators (AEOs) can purchase the required security guarantee. AEOs could be a logistics operator or even a customs broker. Only AEOs registered with Customs can enter LCB Port. The Customs would only register Thai AEOs. Therefore Lao operators are prevented to enter the port whether the intention is to take or bring cargo. The only rare exception if the Lao operator has obtained a special authorization from the Customs. There have been several meetings between authorities from the Lao PDR government and Thailand government but the question has so far not been resolved. Resolving this question is important as it could affect positively the Myanmar trade. With improvements of the corridor road between Yangon and Myawaddi, trade with Thailand has increased along the route. In the future container trucks would be traveling on this route and this would be made easier if Myanmar trucks, like Lao trucks get a direct access to LaemChabang Port. Thus, such operation may hamper the whole efficient transport and connectivity to other routes, although it do not have the direct connections.

5.3 Logistics Standards

Countries in GMS use different standards and this can be used as a non-trade-barrier (NTB) to make trade and transport more difficult. CBTA (article 13) states that "vehicles must…meet technical standards for weight, axle loads and dimensions of the Host Country". The table 5-7 below presents the vehicle technical standards that currently prevail in GMS member states. The table also shows that GMS standards differ

from the standards defined in the ASEAN transport agreement (AFAFGIT).

When it comes to vehicle dimensions, all countries follow similar standards with the exception of PRC and Vietnam allowing long vehicles of 20 m. In vehicle weight standards ASEAN standards (Table 27) show signs of being out of date and they would probably be revised upward. One of the objectives of the table above was to identify the incompatibilities between PRC standards and the rest of GMS member states. PRC trucks have been known to be heavier and longer than average trucks in Southeast Asia. The table in fact show few cases of possible frictions. The maximum allowable gross weight (6 axles and more) is high in PRC but compatible with Lao PDR and Myanmar standards. The problems would be at the Vietnam and Thai borders if PRC articulated 6 axles trucks were intending to enter. The other source of problem would be PRC articulated 3 axles' trucks to enter any neighboring countries as they would likely not meet the acceptable standards. PRC trucks in these cases would have to come not fully loaded. Long articulated trucks may also face problems in Lao PDR, Myanmar, and Thailand. However on long run when differences in standards are relatively small GMS member states may enter into Mutual Recognition Agreement (MRA) to allow acceptable small variations in standards.

Table 27 Axle loads and Maximum Gross Vehicle Weight in GMS

	ASEAN	Lao PDR	Myanmar	PRC	Thailand	Vietnam
Max Length rigid truck	12.2 m	12.2 m	12.2 m	12.0-13.0 m		
Max length articulated	16.0 m	16.0 m		16.5 – 18.1m 20m rd train		20.0 m
Max width	2.5 m	2.5 m	2.5 m	2.5 m		2.5 m
Max height	4.2 m	4.2 m	3.7 – 4.6 m	4.2 m		4.2 m
Axle load		10T, 11T (EWEC)	10T	14 T	10T	10T
2 axles		9.5–15 T(a)	16 T		9.5–15 T(a)	16 T
3 axles	21 T	17-25 T (b)	21 T		25 T	24 T
4 axles	25 T	22.5-29.5T ©		31 T (d)	30 T	30 T (g)
3 axles		26 T		40 T (d)		26 T
4 axles	32 T	35 T	33 T		35 T	34 T
5 axles	36 T	45 T	41 T		45 T	40 T
6 + axles	38 T	49.6 T	50 T	49T (e), 46-48T (f)		45 T

Notes: (a) 4 to 6 wheeler, (b) 6 to 10 wheelers, (c) 8 to 12 wheelers, (d) from IRU, (e) from IRU, 55T was allowed in the past (f) new standards in PRC, (g) 34 T for 5 axles, (h) ASEAN data are 1998;

Sources: "Chinese Road Transport Manual and Dimensions Regulations: An Analysis of the Challenge Ahead" 2013; "GMS Operation Manual for Cross border Road Transport on EWEC", GMS ADB 2013; ASEAN AFAFGIT Protocol 4; Myanmar Road Transport Department; PRC Ministry of Transport.

To sum up, it can be concluded that NSEC is far from being defined as its term suggested, although the physical connectivity has been completed. Along this corridor, it is the software connectivity, set forth already but suspended, that exposes it to hurdles away from the efficient connectivity. In particular, what hinder this corridor are defunct CBTA, unreasonable high cost for transshipment at BCP in Lao territory, disequilibrium of benefits among members, lack of sustainable financing to offset the contradiction between national and transnational infrastructures in Lao PDR, protectionist approaches as well as un-unified standards of transportation facilities. The reasons for these obstacles are complicated and cause of inefficient logistics performance along this corridor, involving all participants in each procedures of the through transportation. And the main concern appears to be in the Lao territory individually, nevertheless, the underlying factors are related to PRC, Lao and Thailand together. For the full potentials of this corridor to the one attracting investment and generating economic activity, measures should be considered practically, jointly and amicably. So the underlying incentives for NSEC development originates from complementarities among the GMS countries.

Measures of Overcoming the Obstacles

As mentioned above, this section aims to introduce some measures of overcoming the obstacles or of improvement of efficient transport and logistics performance. Such measures are individually introduced, however, they are to be combined systematically for designing and implementation.

1. **Governmental Cooperation**

As mentioned before, governmental intervention is a necessity and requirement for transnational road transport along NSEC. Cross-border transport among member economies, constrained from competition up to now, is allowed only between border cities and must be operated under a bilateral or multilateral agreement, which means the road transport industry must entail a certain degree of government intervention. Thus cooperation among members' government is the first priority to push forward since all the measures would not be expected to work provided that governmental cooperation could not be achieved.

For Thailand, in the **Eleventh National Economic and Social Development Plan (2012 – 2016)** (as defined in Footnote 20), regional connectivity has been set forth for the sake of the economic reform through restricting, which could be realized in the integration with market in Brazil, Russia, India and China (the BRICs). Thus connectivity to be created or improved with economies in various regions constitutes as one of the way forward for Thailand. From another concern of social security, connecting such economies, especially with neighboring countries in sub-region and ASEAN has been implemented in the foreign policy in Thailand, for instance, the participation of the Greater Mekong Subregion (GMS) Economic Cooperation Program, in which the objectives can be achieved via economic corridors, accesses to GMS countries and then to ASEAN.

Likewise, greatest efforts to link with GMS through Yunnan and Guangxi provinces and ACMECS has been considered as with high priority in China, which could be certified in the Twelfth Five-Year Plan as implementation of international cooperation in the infrastructure development of high-speed railroads, roads, and river passage through the Mekong. With investments in various special economic zones in Laos, Myanmar and Viet Nam, China, like some economic superpowers (as defined in Footnote 21), are making efforts to ensure economic benefits, especially in logistics and transport strategies, which must have critical influence on trade and investment, extending thereafter the overall strategy in GMS.

China, in particular, takes the strategy of strengthening international cooperation as one of the targets in Belt Road Initiatives, aiming at connectivity and cooperation among countries, the land-based "Silk Road Economic Belt" (SREB) and oceangoing "Maritime Silk Road" (MSR) (as defined in Footnote 22), as shown in the figure below. Among five major cooperation fields, facilities connectivity is the first priority area to conduct for establishing a transport network with neighboring areas to boost the trade and promote the mobilization of resources. Also it is noted that MOU between China and Lao PDR has been signed on 8th September, 2016 for the cooperation of Belt Road Initiatives in infrastructure, finance and investment etc. Also in China's region pursuing opening up, Yunnan is positioned as the hub opening to and connecting with South East Asia in Thirteenth Plan (See Figure 23).

Figure 23 Belt Road Initiatives

Notes: Area in green indicates the territory of China, PRC; in blue one belt economies and in orange one road economies.

Source: https://en.wikipedia.org/wiki/One_Belt,_One_Road#/media/File:One_Belt_One_Road.png

More than most countries, Lao's foreign policy has been confined by its geographical and demographic location. Along with the serious shortage of skilled technical and economic personnel, dealing business with international agencies and people are hard to conduct. Also, the weakness and retarded economic diversification pose Lao PDR's dependency upon France and the United States. However, if Lao could respond to the strategies of China and Thailand, Lao could broaden its range in business partners of donating, trading and investing. Thai traders and investors have dramatically increased is a good verification (as defined in Footnote 23).

So, both Thailand and China have the willingness to cooperate as what they have put into the strategy plans. Lao PDR, due to history and geographic and political concerns, is hesitate to open for cooperate. But as above implied, Thai government could act as the bridge among three members in some certain cases to negotiate cooperation.

2. Associations of Logistics Enterprises

Logistics enterprises must be the main impetus for the efficient transportation through overcoming such obstacles for various concerns. As indicated from the implementation of CBTA, the multilateral agreement has confronted with the embarrassment of being suspended, although great efforts had been contributed since the preparation to the full signing by all members. With the governmental cooperation as the priority to adopt, the logistics enterprises with all participants combined form three members should be the pioneers and one of the main force through an amicable association for the sake of the feasibility and predicative policy preparation. Because these participants, who take transportation every day, have accumulated practical experiences in daily operation and therefore taken their places in the front of the governmental officers. Thus these enterprises have better access to how exactly the transportation in each procedure does be conducted, what the obstacles are and what can be ascribed to, how to mitigate or overcome such hinders in a micro-way, where to be completed or enhanced in regulations or policies, what to be done by the governments and themselves separately and how to realize the maximum profit.

The current development of the logistics industry shows the diversities among countries along NSEC. The industry in Thailand, made of one-half of foreign-owned business and 70% of small business operators in transport and warehousing, is comparatively developed, although it lacks of ICT and is weak in integrated services. Rapid development has been observed in the logistics industry in Yunnan Province since 2001, so there has an extensive network of forwarding services and multimodal transport, thanks to the China's accession into WTO. However, the industry has been remains dominated by small companies, who are lack specialization and push the logistics cost higher. And the logistics industry in the Lao PDR is still undeveloped since the human resource and technology and management capability cannot satisfy customers, and government regulations are complained to be complex.

So, the core function of this association with main participants from three members can be expected to be as a bridge between all logistics' participants and governments in the following perspectives. At the first place, they can only focus on the nature of the efficient transportation and then propose what can be done to improve the whole process. This is the beginning of the reference for policy-makers who may deviate

from the real case due to their lack of sufficient operation experience and also the first critical step to improve the current operations with so many hinders. At the second place, this association can lead the way through customs clearance at BCP. Some major and big enterprises can take the function as the customs broker for small and medium enterprises, who may feel burdensome and unaffordable in payment of guarantee. That is to say, these brokers submit the customs clearance at BCP, rather than the individual one takes, and the cargo of small lots could be consigned to the brokers as a whole set, saving the payment of guarantee conducted by small consignors, members of the association. Such way of consignment is adopted in air freight transport and has been evidenced as an efficient and economical way to forward the cargo. Thus the customs at each BCP can advance or process with such brokers, who are the big enterprises with more proficiency of applying for customs clearance, more worthiness and credit by depositing some guarantee in advance, if necessary and required. In addition, the association can host some forums for scheduled exchange ideas related and training programs for talents in need.

3. Incentives through E-commerce (as defined in Footnote 24)

E-commerce is deemed as an impetus for trade domestics and international. Shopping. 8th December, 2016 witnessed the commencement of bilaterally comprehensive cooperation in Hangzhou, PRC, between Thailand Commercial Department led by the Vice-prime Minister of Thailand Mr.Somkid Jatusripitak and Alibaba Group. In accordance with the agreement, four key fields of cooperation will be conducted: Improving the awareness and capability in E-commerce for small-and-medium size enterprises at local and international market via E-commerce platform, collaborative training program in big data and intelligence of digital technology for governmental officers, jointly setting up supply chain platform for small-and-medium size enterprises in local and international market through logistics and supply chain system and exploring the opportunities in programs of EEC (Eastern Economic Corridor). And the Lazada, an E-commerce platform, as an investment holding company of Alibaba Group, has become the largest E-commerce platform in Thailand (as defined in Footnote 25). This indicates that Thailand is planned to establish E-commerce in the whole country from enterprises to the government.

3.1 E-commerce Trend

19% of transactions of e-commerce emanates from Cross-border transactions in six main e-commerce markets, which are Australia, Brazil, the PRC, Germany, the United Kingdom, and the US. In the PRC alone, the main impetus of e-commerce and leading e-commerce consumer market in Asia Pacific region, it is predicted that cross-border transactions are expected to $160 billion in 2018, rising up from $43 billion in 2013 (Figure 24). With 700 million net users, almost twice as many as the US and Japan combined, the B2C (as defined in Footnote 26) transactions expect to hike up to $2.4 trillion in 2017 from $1.5 trillion in 2014. (Figure 25).
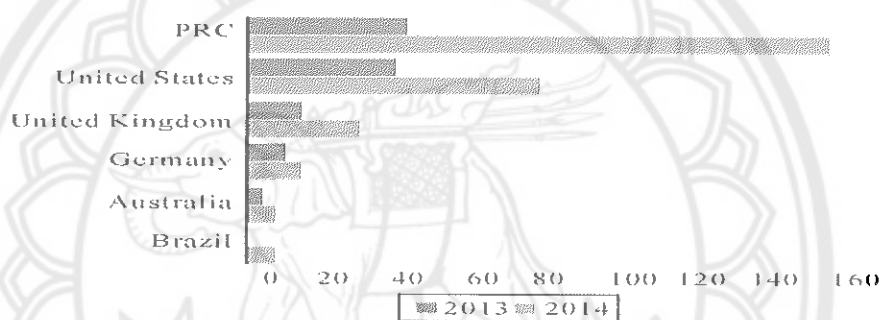

Figure 24 Cross-Border E-Commerce Flows—Selected Economies ($ billion)

Source: Paypal, 2014

In particular, majority of ICT (70%) in Asia and the Pacific has been adopted in transport and communication facilities, paving the way to the modern trading system and data-driven electronic systems to improve border processing and government programs. This is the efficient way to reduce trading cost and do business on line.

On the firm level, ICT (Information and communications technology) (as defined in Footnote 27), a prerequisite for E-commerce, is used to optimize process efficiency or reduce operating and/or administrative costs. It is also used to learn more about consumers and markets for product and services development. In the logistics industry, ICT expedites the exchange of information between stakeholders, enables track and trace cargo, optimizes the use of infrastructure, and monitors the performance of

supply chains. Governments have used ICT to provide services more efficiently. For example, GMS countries introduced automation of Customs services and committed to the introduction of national single windows (NSWs) as their contribution to an ASEAN single window (ASW).
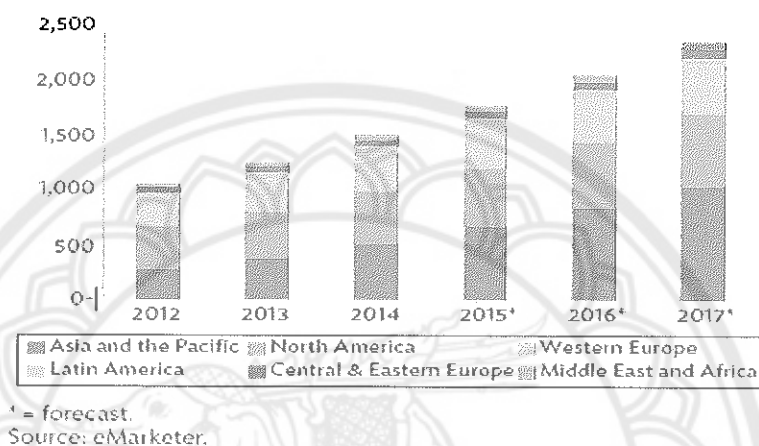

Figure 25 Global Business-to-Consumer E-Commerce Marketplace by Region, 2012-2017* ($ billion)

Note: * = forecast

Source: eMarketer, 2014

3.2 E-commerce Possibility

While the use and applicability of ICT in trade and transport covers a wide spectrum, this section briefly reviews progress in using ICT systems and related digital infrastructure in trade processes. There are stark differences between GMS countries when it comes to the introduction of automation and ICT systems.

The Networked Readiness Index (NRI) measures how well an economy is using ICT to boost competitiveness and well-being. The scores and ranks for GMS countries for three selected indicators (political and regulatory environment, Infrastructure, Government usage) are provided in Figure 14 and Figure 15. The variance in the performance of GMS countries in the NRI is relatively narrow as exemplified in the narrow range of scores. Globally, GMS countries rank in the lower

half and only fare relatively well in the government usage indicator. The generally low ranks of GMS countries indicate that there is still more work to be done to take full advantage of ICT opportunities for both the private sector and government.
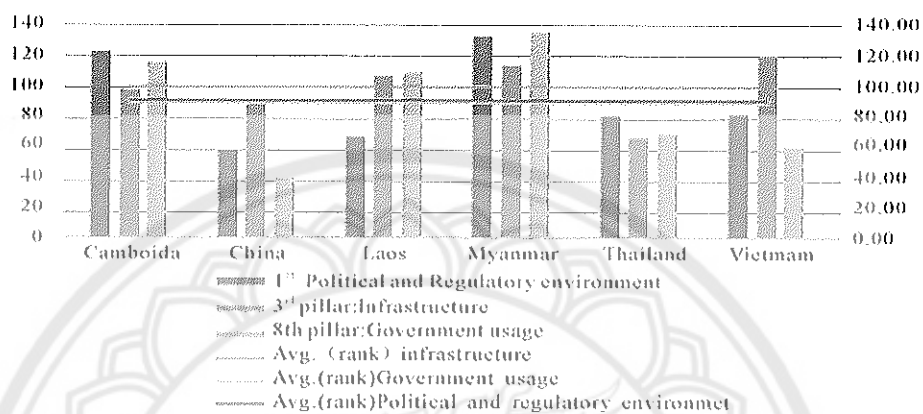

Figure 26 Selected indicators from the Networked Readiness Index-Score (2016)

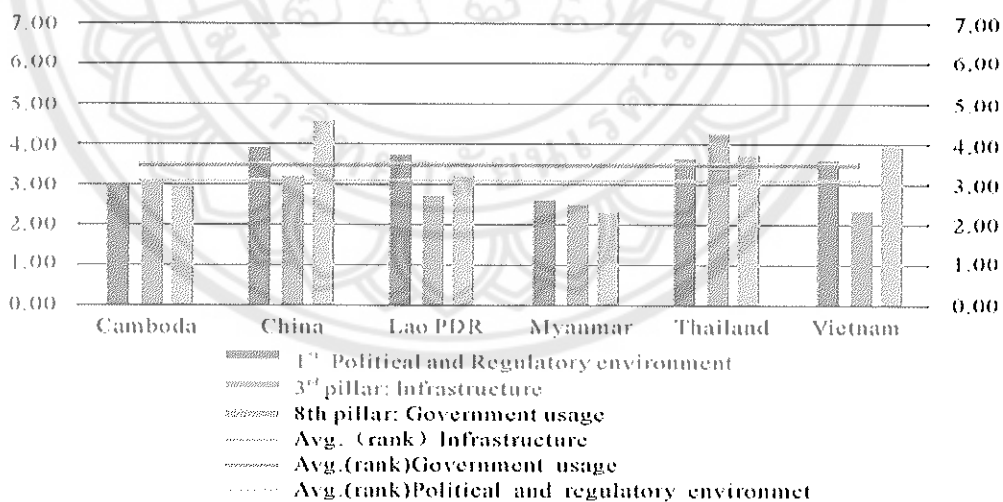**Source:** World Economic Forum, 2016

Figure 27 Selected indicators from the Networked Readiness Index-Rank (2016)

Note: Rank: out of 139 economies; score 1 (worst) to 7 (best) Averages are GMS averages in the respective indicators.

Source: World Economic Forum, 2016

Regarding the micro participants, the intensity of e-commerce usage is largely illustrated by different degrees of accessibility. Here we use four e-commerce readiness indicators, namely, internet penetration, usage by firms, the policy environment, and logistics to explore the possibility of E-commerce as well as the gap between members of GMS.

Internet penetration (Table 28).

Table 28 GMS Internet Users (per 100 people) (2004-2013)

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
GMS	5.9	8.5	10.4	12.6	14.4	17.4	20.2	22.8	26.0	29.0
Cambodia	0.3	0.3	0.5	0.5	0.5	0.5	1.3	3.1	4.9	37.9
Guangxi	5.8	7.1	7.9	11.7	15.2	21.2	25.2	29.4	34.2	32.8
Yunnan	4.7	5.4	6.1	6.7	12.1	18.5	22.3	24.8	28.5	12.5
Lao, PDR	0.4	0.9	1.2	1.6	3.6	6.0	7.0	9.0	10.7	12.5
Myanmar	0.0	0.1	0.2	0.2	0.2	0.2	0.3	1.0	1.1	1.2
Thailand	10.7	15.0	17.2	20.0	18.2	20.1	22.4	23.7	26.5	28.9
Viet Nam	7.6	12.7	17.3	20.8	23.9	26.6	30.7	35.1	39.5	43.9

Sources: World Bank. World Development Indicators database. April 2014; China Statistical Yearbook database. 2005-2014; and ADB Staff estimates

Both companies and consumers need to adopt the technology at the same time. The capabilities what companies require are researching and locating foreign customers and market over the internet, marketing and media over the internet, communicating from the offer to conclusion of contracts, and incorporating e-commerce in operations as well as translating this connectivity into business use. Better performance in business usage can be found in the PRC, India, Indonesia, Malaysia, and Thailand than other with similar ICT infrastructures.
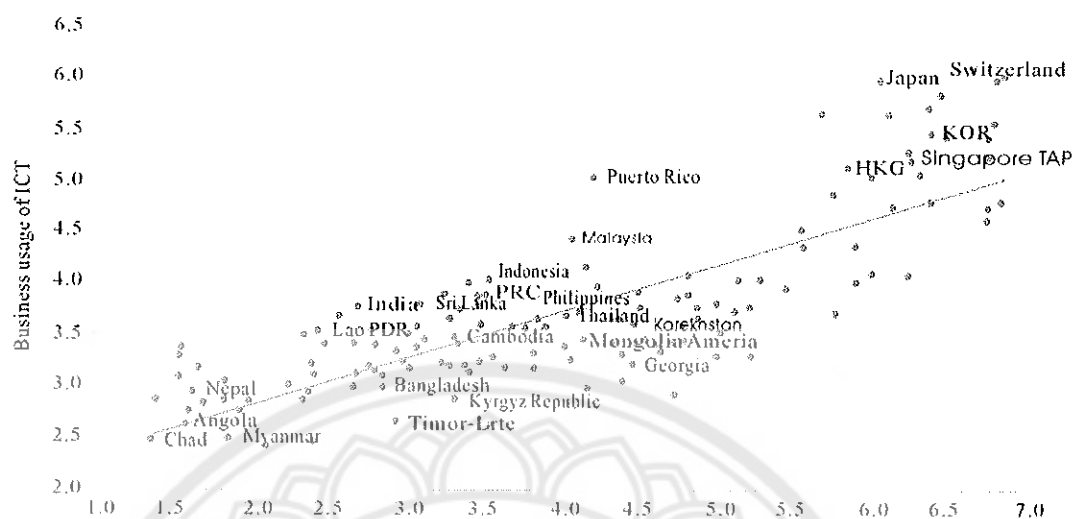
Figure 28 Quality of ICT Infrastructure and Business Usage from ICT—Selected Economies, 2014

Note: PRC=People's Republic of China; HKG=Hong Kong, PRC; TAP=Tai Pei, PRC
Source: World Economic Forum, 2014

Due to the cross-border nature of e-commerce, to promote economic growth and competitiveness should take a harmonized regional legal framework as a prerequisite, including the presence of such framework and their supportive government policies. It is estimated that 73% of economies have laws on e-transactions, only 38%, however, have involved laws on consumers' protection and 29% on privacy in Asia and the Pacific region. Also, it is reported by PRC's Ministry of Foreign Affairs and the Ministry of Commerce (2015) that incorporating e-commerce into trade promotion strategies have been set forth for border e-commerce as an approach to promote trade between inland cities in the PRC and Central and Southeast Asia.

Logistics underpinning e-commerce transactions for goods is more complex and sophisticated in B2C and C2C (customer–to–customer) transactions. Logistics keeps a bottleneck for the growth of the regional e-commerce market since it involve millions of small, individual parcels, various paths for delivery and warehousing for the order fulfillment, sorting, distribution, and parcel returns. So in order to inspire the volume along NSEC, logistics operation of efficient transport connectivity is the

prerequisite for E-commerce, although the hardware of E-commerce is ready now.

4. Border Economic Zone

4.1 General introduction to BEZ

A Border Economic Zone (BEZ) is a cluster of activities that is associated in varying degrees of collaboration with cross-border networks of productive activities that take place between two or more countries having varying stages of development in order to achieve well-defined goals selected from a broad spectrum of development options (Montague J Lord and Pawat Tangtrongjita, 2015). The BEZ, a main initiative to promote economic links among neighboring countries, is composed of hard and soft infrastructure that makes up the cluster of activities in the area as below Figure 17.

The figure shows that the industrial park is the core component, the geographically delimited area on either side of the border or straddling both sides. Other components are cross-border value chain, transport and logistics, trading costs, legal and regulatory, socio-economic development strategy for the area, SME development, business development service and regional and global linkage. Among these components, included are six main stakeholders, who are also the beneficiaries separately and jointly. Governments can expect political and social stability accompanying increase in cross-border trade and investment. While the business sectors, the large companies or SMEs, can either find the opportunity to benefit from lower trading costs and thus expand exporting in GVC (Global Value Chains) or win more access to participate fully in international trade via business development services and facilitation arrangements. In addition, local households, in the process of expanding trades from enterprises, have a better chance to improve their living standards through better access to employments, trading activities and other related business and services of health care and education. This is particular important for those underrepresented groups like women. Further, household of development partners can expect inclusive growth and social programs in lesser developed border regions.

Chiangkhong district, the potentials could be in industries in Agro-processed industries, canned fruits, jewelry and precious stones, garments, assembly electronic parts and electric appliances, machines, agricultural machines, medical equipments, human drugs, printing and file producing and in agricultural by contracting

farming to supply for food and agro-processed industries for domestic and international markets as well as providing logistics service as a distribution center.
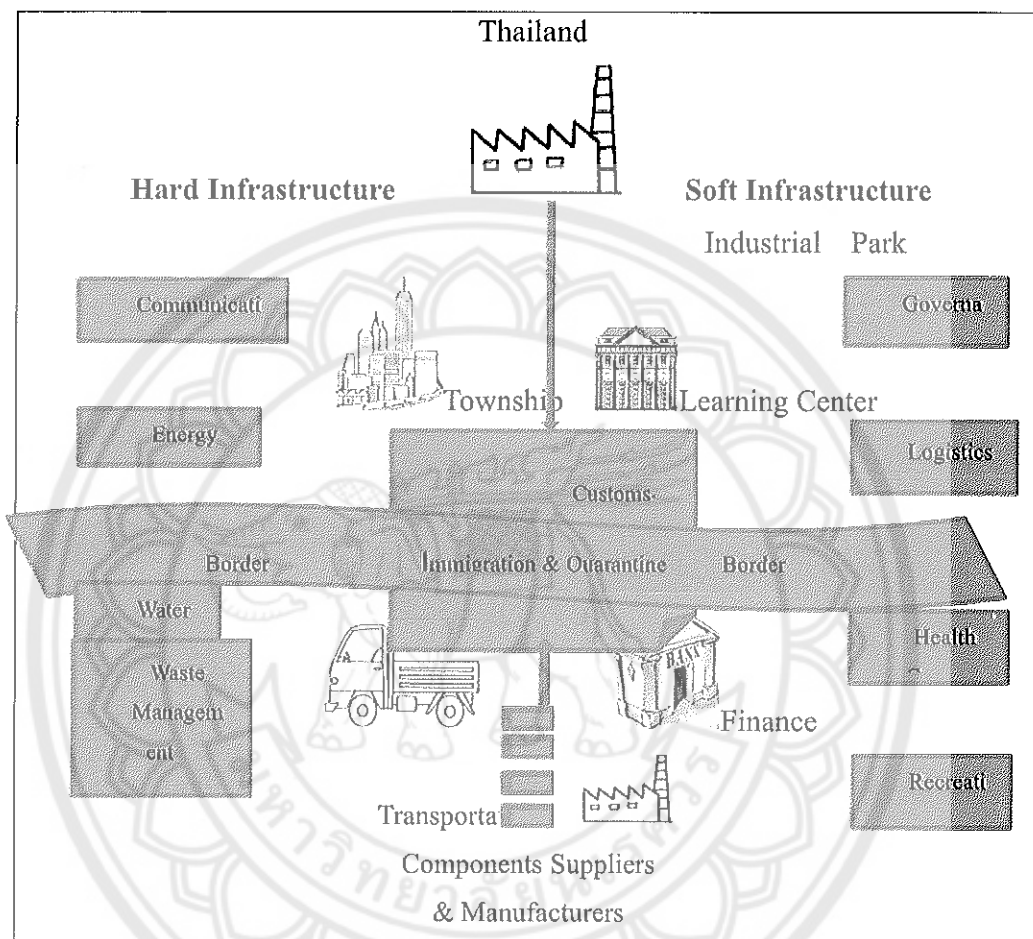

Figure 29 BEZ Cluster

Source: Montague J Lord and Pawat Tangtrongjita, 2015

4.2 BEZ in NSEC

Taking the relative factor endowments and complementarities of NSEC subregions into account, ADB (2011) (as defined in Footnote 28) suggests the trade, tourism, power, logistics, and technology-intensive industries could be considered as the focus to invest in Western Sub-corridor of NSEC.

Indicated from the Figure 18, there is a Border Economic Zone, in Chiang Rai, one of the core areas of China–ASEAN trade. The BEZ covers development of human resource, trade, infrastructure, and institution. This is in line with the vision set out in **The National Economic and Social Development Plan (2012-2016)** (as defined in Footnote 29) of creating regional connectivity for social and economic stability. In addition, since the trilateral agreement between Thailand, Lao PDR, and PRC has not yet been enacted, all cargo will continue to be transshipped at the border. This regulatory barrier offers the opportunity for Lao PDR to provide value-added services to the fruit trade such as sorting, grading, packaging, etc. In addition, a clean, refrigerated transshipment space could help improve the quality of the supply chain, thereby increasing product quality and extending shelf life.
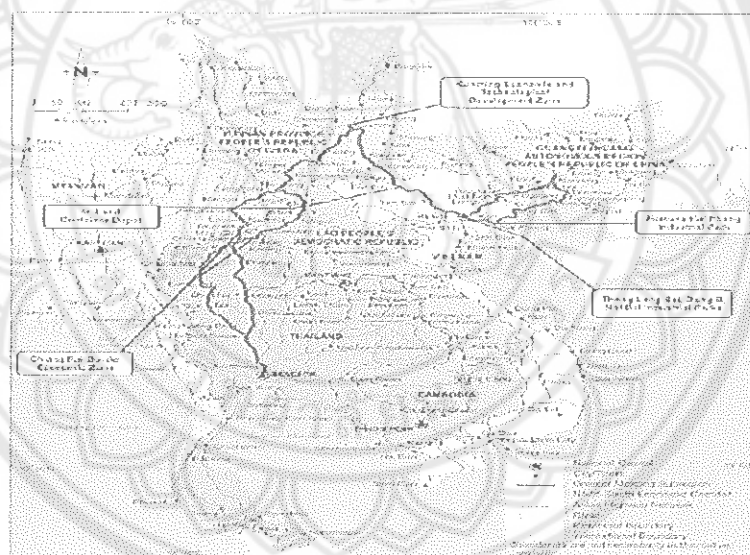

Figure 30 Major Special Economic Zones in NSEC Areas

Source: ADB, 2011

4.3 Cooperation with AIIB

The Asian Infrastructure Investment Bank (AIIB) (as defined in Footnote 30), designing for the long-term economic development and support for infrastructure as regional integration and foreign policy tool is defined as

an international financial institution, a natural inter-national extension of the infrastructure-driven economic development framework (as defined in Footnote 31). In addition, both Thailand and Lao PDR are funding members of AIIB (as defined in Footnote 32).

As the main financier of One Belt One Road to construct new ports or to upgrade existing facilities, AIIB can be a good access of financing for projects under SREB/MSR (Silk Road Economic Belt and 21st Century Maritime Silk Road)., because it is understandable that increased or improved regional connectivity would be greater access to the huge China market and attract the investment from China (as defined in Footnote 33).

4.4 Cross-Border RMB Settlement by SDR (RMB)

Cross-border RMB settlement refers to all cross-border transactions settled in RMB, including current account cross-border RMB settlements such as trade in goods, trade in services, proceeds and current transfers, and capital account cross-border RMB settlement such as direct investment, cross-border financing, as well as all other RMB settlement businesses approved by the People's Bank of China (as defined in Footnote 34). One of the advantages and the features are to avoid exchange rate risk and thus to lower the exchange cost with high speed of settlement. In addition, since Oct. 1, 2016, the RMB has been eligible for joining the Special Drawing Rights (SDR) (as defined in Footnote 35) basket and thus become an international reserve currency in the SDR basket (as defined in Footnote 36). As a supplementary foreign-exchange reserve assets, the SDR comes to prominence when the U.S. dollar is weak or otherwise unsuitable to be a foreign exchange reserve asset, so that SDR has been widely adopted in settlement for international transactions and traded on the main foreign exchange market. So Cross-border RMB settlement by SDR could be an ideal instrument to stabilize the financial market and facilitate the trade settlement.

CHAPTER VI

DISCUSSION AND CONCLUSION

This chapter is the summary of the research result based on the previous five chapters. And limitation of this thesis is also presented for further improvement.

Discussion

This research need to be improved in the following aspects.

The first perspective comes from the hypothesis of this research. This thesis only focus on the main or central sub-corridor of NSEC, the rest two western and eastern sub-corridors needed to be included for the whole understanding of NSEC. Also, the freight volume along this corridor is limited in the volume from the trade between Thailand and Yunnan province. There may some frontier trade between Lao and Thailand and between Lao and Yunnan. There still some illegal trade, which data could not be collected or verified.

The second facet originates from the review of literatures. Although literatures' review is conducted to the end of the thesis, it is unavoidable that some literatures are disregarded due to the limits of searching engines and resources.

The third side relies on the data collection. For the logistics performance in time and cost over distance, data in Mohan is hard to collect and sometimes some datum are not in conformity with data of other sources or have not published openly, which may result in the deviation in real and predicative statistics higher. In addition, much more interview should be taken for more objectiveness of the result and some governmental officials, traders, transit and transport service providers should be included in the interviewees. What's more, data should be collected for support the solutions in BEZ and settlement by RMB with SDR.

Conclusion

As indicated in chapter 1, there are three targets for this research, namely, logistics performance along NSEC, potentials of this corridor in the next ten years (2016-2025) and most critical importantly, the efficient transport connectivity along NSEC.

1. Logistics Performance along NSEC

To study the logistics performance along NSEC, the pilot project under ADB's initiative, this thesis firstly focuses on time and cost over distance with the reference of UNESCAP Time/Cost Methodology and then adopts interviews to collect other information other than time and cost. Although the physical connectivity has been finalized, we can reach the conclusion that both the time and cost in the part of Lao PDR remain irrational higher due to operations in border crossing points at Huaxay (Thailand- Lao PDR) and Boten (LAO PDR-Yunnan province, China) for transshipment and customs clearance. For the similar concern, respondents in the interview also express unacceptance about such higher cost and delayed time in this part, which is even much higher than the one in EWEC in time over distance. While the interview, with the guideline of LPI, highlights the real-time shipment, security concern, cooperation and coordination among all participant, like shippers, consignees, customers brokers, all customs officers, carries and forwarders, in the whole process. So the interview is design for collecting information with time and cost, but much attention is paid to what the software connectivity care. What have been listed in the interview in part I, the evaluation of logistics performance to the potential of this corridor, in terms of the reasons of inefficiency in customs clearance and in the whole transport process, have been recognized by much higher percentage. This indicates that the obstacles along NSEC are not in time and cost, but in many factors, such as the implementation of CBTA, the efficient and effective customs clearance at points of border crossing, the successive investment and maintenance of road in Lao PDR, the benefits of Lao PDR and improvement of facilities and working efficiency of all parties. Such result implies, on the one hand, NSEC still remains as a transport corridor with physical connectivity being completed, on the other hand, hindrances of the efficient transport connectivity rely on the software connectivity in every aspect, which makes the countermeasures in urgent need and complex.

Besides, although we can conclude above un-satisfaction of logistics performance, the NSEC, compared with multimodal transport of waterway (Greater Mekong River) or sea transport with road transport, due to its indispensable positive influence in total transport time, is the main passage for trade of fruits and vegetables between Thailand and Yunnan province, thanks to the trade facilitation in ASEAN-

China Free Trade Area (ACFTA) (as defined in Footnote 37). Thus in order to find out solutions to such obstacles, measures are proposed accordingly and individually. Since the transport along NSEC must be conducted via border cities, CBTA is discussed as the first cause for above inefficiency from the perspectives of origin, time-assuming negotiating and ratification processes by each member of GMS, contents or its coverage and why the CBTA cannot be carried out completely or suspended in some circumstances. Provided that if CBTA could be implemented in accordance its full terms and conditions, transshipments, repeated customs clearance with complicated process and documents could be avoided. That is why the first priority of solutions is to expect the governmental cooperation at this concern to make the CBTA being carried out due to the demand of each economy in development of economic concern. Considering the diversities among members in economy, political and history background, and the NSEC being completed for ready usage, an association consisting of major logistics enterprises in all members is proposed to act as an interim, temporarily and sustainably, between companies and members of governments for the benefits of all participants and proposing suggestions to governments for better logistics operations and regulations as well as training talents in this industry for companies and governmental officials. In addition to this, such association could help set a uniform of logistics standard as a reference for policy makers to reduce its contradiction to the utmost way. Some of respondents may claim that there are some associations in Lao, Thailand or China, but they are not the alliance of logistics companies, pursuing for all shared benefits, but self-centered one with strong protectionism.

In this thesis, there is worthy of noting that we discuss an important underlying factor for the inefficient transport is the unbalanced benefits for Lao PDR, which may for some certain sense correlate with the inefficiency of officials and the government as well as the informal charges required since they must undertake the maintenance of the road and operations for border crossing. For such concern, this research also takes the governmental cooperation and logistics association for solutions accordingly. At the same time, BEZ is proposed for Lao PDR, providing value-added services for traders or forwarders by taking use of the current situation. Since the trilateral agreement between Thailand, Lao PDR, and PRC has not yet been enacted, all cargo will continue to be transshipped at the border. This regulatory barrier offers the

opportunity for Lao PDR to provide value-added services to the fruit trade such as sorting, grading, packaging, etc. In addition, a clean, refrigerated transshipment space could help improve the quality of the supply chain, thereby increasing product quality and extending shelf life. Therefore, Lao PDR could be a beneficiary due to the trade between Thailand and Yunnan and exploit itself advantages to serve the efficient transport for its own benefit, sustainably and reasonably. This is one of the original ideas in this research.

In addition, among reasons blamed for the inefficiency of transport, bad road condition can be fallen into cause of the hardware infrastructure. For the maintenance of road and sustainable development of NSEC, AIIB is introduced for financing of what NSEC requires for maintenance and long-term investment under One Belt One Road Initiative, which conclude the construction of physical connectivity, in particular the connectivity along corridors, as the priority. Although Lao PDR is a landlocked country for itself in developing economy, it is a land-connectivity for connection between Thailand and Yunnan. So it is be of certainty that both Thailand and China may make every effort to support the connectivity via Lao. So for the lack of the sustainable financial infrastructure, AIIB is one of the best accesses to realize the financial infrastructure for this corridor. And at the same time, this concept constitutes another originalities for this thesis.

2. Potentials along NSEC

Although the NSEC entails such hindrances in software connectivity, the hardware connectivity contributes to the general growth of freight volume in the past ten years (2006-2015), before and after the total completion of NSEC in 2013. Thus we can conclude it is mostly the trade of perishable goods between Thailand and Yunnan province that inspires the logistics demand along this corridor foreword and most importantly is that the completion or improvement of physical connectivity boosts the trade with higher impetus. So if the corridor can be improved in both hardware and software connectivity, with the latter as the core, much more volume of trade and then the freight, with benefits for all members, can be expected sustainably. Such concern makes the forecasting of the freight volume necessary, which is the general basis for solutions to the current obstacles and accordingly for suggestions of exploiting potentials along NSEC.

For forecasting of the freight volume in this research, fuzzy linear regression is adopted. Parameters as GDP, POP, FDI, Road Tonnage and trade between Thailand and Yunnan are analyzed for settling down the close correlative factors through grey correlation analysis. As previous studies point out, the foreign trade is the key origination of international transportation, so the influencing factor of freight volume along the NSEC is the trade between Thailand and Yunnan. Another direct correlative element, indicated in the predicative result, is the GDP in Yunnan province. And after the two factors are forecasted by about 7% and 8% of annual increasing rates separately, the final forecasting is to be represented. Combined with the predicative result in the year of 2006-2015, the total result represents a general growth trend.

However, this conclusion should be interpreted in optimistic perspective and pessimistic approach at the same time. Optimistic result is considered due to the complementary of the trade between Thailand and Yunnan, especially after the commencement of the China-ASEAN Free Trade Area (CAFTA) since 2010. Nevertheless, such tendency of the trade is not the lasting necessity and the CAFTA is neither a guarantee of the trade. Logistics performance of efficient transport connectivity, to a great extent, is the two-edged sword in this this case. Supposed that the efficient transport could be realized gradually, the confidence in the trade and logistics could be inspired eventually, which might spur the transportation to a greater percentage than what has been forecasted. But, provided that the logistics performance along the NSEC remains to be the present one or even to deteriorate, the freight volume might diminish gradually, as the result of which, the corridor might turn to be suspended and let the previous investment be a big waste. This is what the pessimistic future might look like and why we should find solutions accordingly.

For such general purpose, solutions are to be considered from two perspectives: one it to improve the logistics performance, which has been concluded at above part 6.1.1, and the other is to facilitate the trade with easiness, convenience and security. For the latter, this thesis proposes the E-commerce transaction between Thailand and Yunnan through discussion of the E-commerce trend and possibility, which can be constituted as a promising idea for future Thailand-Yunnan trade. What's more, settlement with RMB, a new passel in SDR, is suggested also, for the concern of the security in finance, which is critically significant for Thailand. Therefore, the two

concepts are fresh notions for future Thailand-Yunnan trade and thus for the main part of freight volume along the NSEC.

3. Determinants of ETC

After the conclusion for the logistics performance and potentials along the NSEC, the efficient transport connectivity is to be clearly answered. What are to be indicated are how to understanding the term ETC-efficient transport connectivity and what are required for ETC along the NSEC and then what is the implication for other corridors of GMS.

For the definition of ETC, from the literal meaning, the adjective efficient refers to (as defined in Footnote 38) being able to work well or to produce the right result quickly. This is to say, the efficient transport connectivity requires a timeliness of transport as the first priority, serving for full sense of connectivity-hardware and software connectivity at the same time. From the concern of logistics' term, ETC is indicated by timely transport with the least time and cost over distance and the utmost of convenience, security, optimization and satisfaction. So ETC is characterized by timeliness as the core with the connectivity as the prerequisite and support for maximum profits.

In particular and specific aspects, speedy conveyance, in essence, is what logistics requires and always correlates with minimum cost. These are two "rights" among the six rights to define the logistics-right time, right cost, right product, right place and right customers. So efficient transport connectivity primarily focuses on the time and cost indicators, since more unnecessary time consumed must entail higher cost due to more non-value added operation(s) and/or bigger commercial risks in wastage and spoilage to goods during transport. To pursue for such expectation, the connectivity in both hardware infrastructure and software infrastructure is needed (Table 29).

Table 29 Efficient Transportation Connectivity along NSEC of GMS

Efficient Transportation Connectivity					
Hardware Infrastructure			Software Infrastructure		
Determinants	Responsible By	Purpose	Determinants	Responsible By	Purpose
Physical Infrastructure (Finished in 2013)	Governments	Completion of Physical Links (minimizing the general cost and time)	Governmental Cooperation (CBTA)	Governments	Connectivity Agreements to legitimate the cross-border transportation
			Associations	Enterprises	Lobby Group
Connection of Missing Links (Finished before 2013)	Governments and/or Investors	Completion or Improving of Physical Links (minimizing the general cost and time	Single – Window BCP	Governments & Brokers	Smooth Customs Formalities
			BEZ	Governments & PPP	Improving Value of Consignments
Maintenances	Governments	Sustainable Improving of Infrastructure (keeping the cost and time not to be deteriorated)	AIIB	Governments	Sustainable Financing Mechanism
			E-Commerce	Enterprises & Governments	Impetus of Cross-border Trade

Notes: Enterprises mainly refer to shippers, consignees and brokers

PPP: Public Private PartnershipEnterprises include shippers, consignees, freight forwarders and importing and exporting companies.

So, ETC can be defined as a systematical set of hardware and software structures, facilities or infrastructures in the forms of road connection as the prerequisite in the former and non-tangibles (such as governmental cooperation agreements, unified operational regulations and coordinate institutional frameworks, transparent governance mechanisms, and social networks) as the supporting of the hardware infrastructure, in the transport process focusing on reasonable least time and cost along a corridor within a cross-border community or sub-region for the purpose of supporting cooperative and coordinate social and economic development of sustainability to a greater sense. Also, ETC is characterized by the followings. The first prior requisite is the physical connections; the key to work relies on the software connectivity, especially in border crossings; the focus is to realize the least output in time and cost; the target pays to the social and economic development among members generating from foreign trade, for both present and future considerations.

In particular, ETC along NSEC (central part) of GMS (Table 29) is indicated by the hardware infrastructure (the completions of road connection from Bangkok, Thailand to Kunming, Yunnan province of PRC via Lao PDR for border crossings) and software infrastructure (such as CBTA, unified logistics operation and standards, logistics association made of main logistics companies from three members, simplified one-stop customs clearance, BEZ and sustainable financial mechanism) in the whole process of transport of goods as quick as possible along NSEC of GMS for satisfying the trade among members and thus bringing along the social and economic development of sustainability for member economies. Thus for realization of ETC along NSEC, what are to be further required are in software connectivity-implementation of CBTA, setting-up an association of logistics enterprises, a framework for inspiring trade through E-commerce and BEZ, financing, and mitigating the risks in trade.

To sum up, to study the logistics performance along NSEC is to find out why the corridor has been completed its physical connection but cannot work like what economic corridor look like, what are the particular obstacles and where they occur. And to predicate the cargo volume along this corridor is to prepare the solutions to such hindrance for either present concern or sustainable future strategy. Most critical importantly, logistics performance and forecasting of freight are the backup for working out, the core target of this research, what is ETC and how to understand and realize ETC

along NSEC of GMS, with problems-causes and present-future into account.

    1. ETC Model

        The model illustrates the combination, the relationship, determinants and the criterions of ETC along NSEC of GMS (Graph 8). In particular, there are usual the case that one determinant has been set due to criterions, which are more than one or two and are arrayed in the sequence of importance decreasing.

        ETC is composed by hardware connectivity and software connectivity, with the former as the backbone and the latter as the supporting. The hardware connectivity, as the prerequisite of ETC in lowering the time and cost of transportation, could be realized through physical construction of road or connecting the missing links, improving the road condition and its maintenances, which the governments should take the primary liability and at the same time introduce PPP as a financing alternative.

        The software connectivity is a system supporting by six determinants, among which, each of them is designed for different purpose(s) from varied aspective though, the deficiency of any individual one will be detrimental to others and the whole system. Since the NSEC is a crossborder infrastructure invilving in more than two countries, the first priority is to be supported by the governmental cooperation and agreements, which serves as the legitimation gaurantee for such crossborder transportation of cargoes, passengers and vehicles. At present, the agreements may consist the bilateral agreements and CBTA, with the former continuing and the latter suspended. This model takes only the CBTA as the first determinant in software connectivity due to its full coverage of rules and regulations for crossborder transportation of cargoes, passengers and vehicles. In additon, the core item of CBTA relies on the "customs transit system" (CTS), serving for the singel-wiondow BCP at customs declaration, which is the way for simplifying the customs procedures and thus minimizing the cost and time at BCP. Thus the continuing bilateral agreements should be consituted by CBTA, although CBTA should be adjusted with more feasibility.

        Since the CBTA cannot be fully implemented at the beginning of the integration, ETC must be greatly influenced in a negetive way. Such consequence might occur in the period when the CBTA would be changed in some items in case of need in the future. So the temperary or the interim deternimant, for both present and future concern, should be taken into account all the way of ETC. For these concerns, the

determinant of associations of logistics enterprises is designed into the model. Such associations should include major enterpriese in trade, customs brokers and logistics companies in three countries, who are the practitioners in transportation, domestic and overseas. It has been expected that such associations are much more experienced in cargo's handling at BCP and professional in practice. So they understand the details of the whole operation in a specific way and can thus propose what are the hinderance or constrain of ETC and how to overcome or improve in practice, which are what the policy makers are insufficient and should be taken into account in all facilitation agreements.
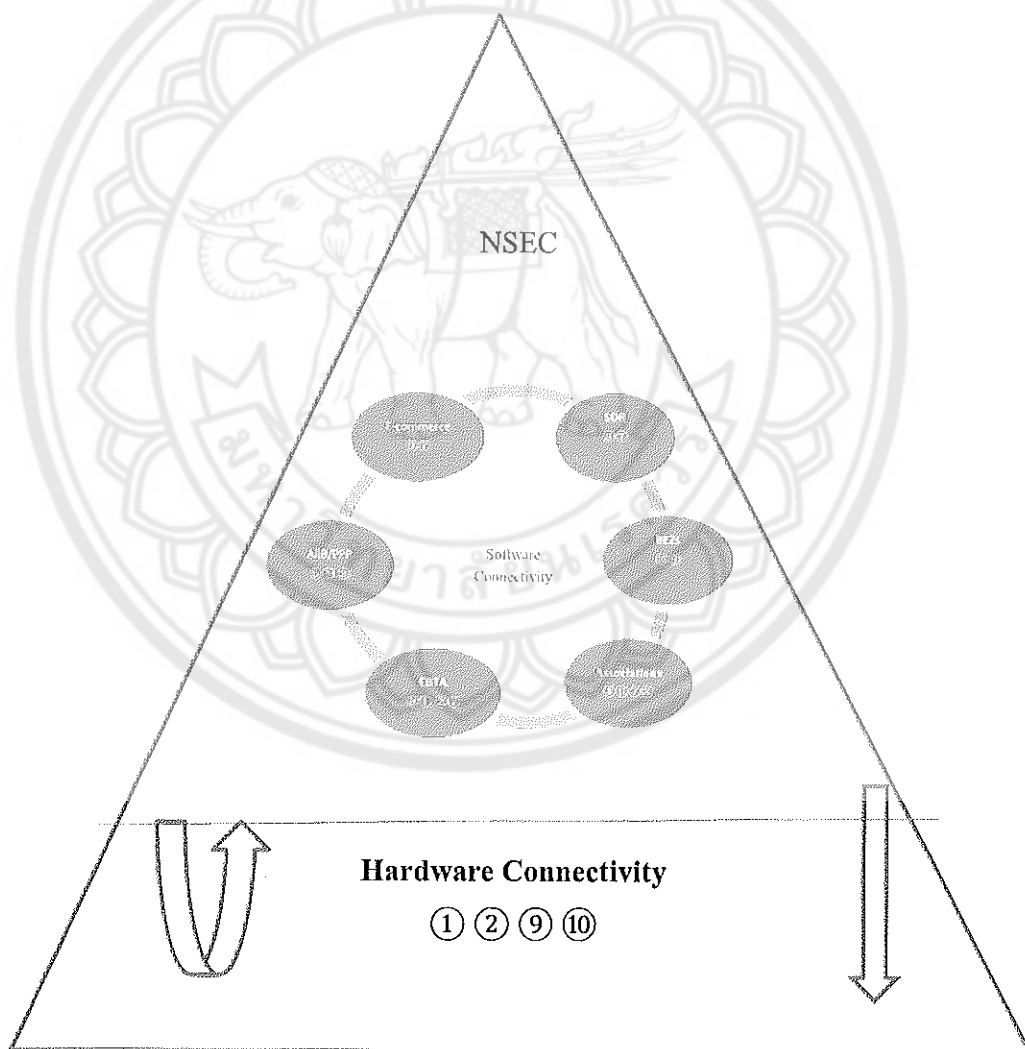

Figure 31 Model of ETC with Criteria

Notes: ①-⑨ refer to each criteria of ETC along NSEC of GMS.

① Cost minimizing; ② Time minimizing; ③ Legitimations;

④ Coordination; ⑤ Financing Mechanism; ⑥ Capabilities;

⑦ Timeliness (including the traceability); ⑧ Reliability and security;

⑨Incentives; ⑩ Flexibility (including providing value-added services, transshipment of modes of transport).

Moreover, the insufficient working talents could be trained through associations in regular or temporary schedules. So associations can undertake such coordination between enterprises and the government, between the reality and the expectation and between constrains and possible measures.

BEZ as the determinant is for the consideration of the benefit distribution among three members, especially for the benefit of Lao PDR, the land-bridge for transportation cargoes between Thailand and Yunnan province of PRC. Throught runing the BEZ, much value could be added to cargoes and thus the Lao PDR could expect more profit in a sustainable way. And at the same time, some social impact could be gained from employment.

Financing mechanism is a necessity since the feasibility study to the successive progress of ETC. The biggest two parts need of the investment rely on the physical construction of infrastructures and the continuing maintenances, both of which can only be supported by sustainable mechnism. Through the investment of financing, the ultimate goal of mimimizing the cost and time can be realized. AIIB as a multilateral and governmental financing institute, takes the investment in infrastructures as the key target for improvement of connectivity in Asia and therefore should be considered as one of the determinants of ETC, due to the geographcial position of GMS to Chinese government's strategy in the long run. And PPP could be an alternative.

A ETC should take the consideration of shippers and consignees at the first place. In international transactions, what trading partners might have emphasized is to minimize the trading cost with lower risks. A wide variety of commerce, on the one hand, is conducted in E-commerce, spurring and drawing on innovations in electronic funds transfer, supply chain management, Internet marketing, online transaction processing, electronic data interchange (EDI), inventory management systems, and

automated data collection systems. So E-commerce addresses the need of business organizations, vendors and customers to reduce cost and improve the quality of goods and services while increasing the speed of delivery. It can be concluded that through E-commerce, the shippers and consignees can be inspired with more access and opportunities, which must involve the transportation of physical items in some way. So the determinant of E-commerce has been deemed as the way to tap the potentials along NSEC. On the other hand, in order to avoid the financial turbulence due to the deficit, settlement throuh SDR in RMB has been set in this model.

It should be noted that there's quite obviously a lot of synergy between the hardware connectivity and software connectivity, among determinants in software connectivity and among all determinants in both hardware and software connectivity, although each one has been indicated above. And the criterions consisting of each determinant are more than two, with the former as the focus. Also, all 10 criterions combined to the ultmost are the targets of ETC, which expect the smooth transportation of cargoes and vehicles with the least ouput.
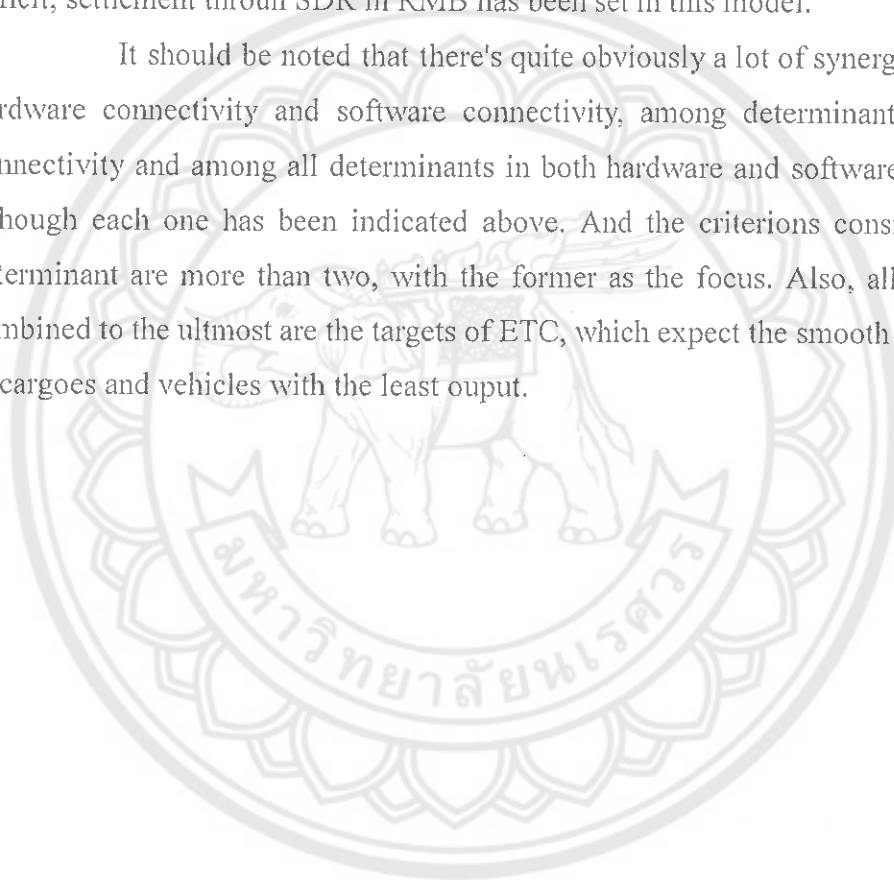
CHAPTER VII

RECOMMENDATION FOR FURTHER STUDY

GMS remains to be a hot topic in Asia, especially for member economies, when some countries is pushing forward strategies in economic reforms and international cooperation, such as Looking East by Myanmar's government, Thailand's Thirteenth National Economic and Social Development (2017-2021), China's Thirteenth Five-Year Plan (2016-2020) and Belt Road Initiative and Lao's economic reform as well as the commencement of AEC. Although one of the importance of this research is to make further implications and preparation for such policy makers, this research is to be expanded and developed in following aspects.

At the first place, as a cooperation program across borders among economies with much diversities in politics, economy and social development, so the cooperation for economic concern could not be planed or implemented individually. It is worthy of noting that political consideration such as the information sharing and security are always the critical parts unavoidable. So separate research is required at this field to support the possibility and degree of further cooperation.

In addition, NSEC, among three corridors of GMS, is not an independent and segment infrastructure. One the one hand, for the central sub-corridor studied in this research, the section what has been discussed is set from Kunming, Yunnan province, PRC (the origin) to Bangkok, Thailand (the destination). In real practice, it is possible to cut the corridor off to a segment or limited distance. So further research should pay attention to where the central sub-corridor stretches at Kunming and Bangkok, which may imply a bigger markets for both Thailand and Yunnan. On the other hand, among three corridors of GMS, they are not separately elongated but intersected at some points. So this research should be extended to the coordination of ETC in the whole GMS and later in the AEC and in ASEAN. Also, how the software and hardware infrastructure improve along the NSEC had a profound impact on supply chain structures for time-sensitive, high-value cargo need to be extended.

Besides, for the trade between Thailand and Yunnan province, the main origin of the freight volume along NSEC, another study should focus on the complementary and competitiveness accordingly for the sustainable industrial upgrade. Similar studies have been made, however, the focus does not rely on the long-term coordinate development, taking GMS as a whole rather than centering on individual economy.

Further, how does the GMS coordinate and connect with Thailand's Thirteenth National Economic and Social Development (2017-2021) and the Version 4.0, China's Thirteenth Five-Year Plan (2016-2020) and Belt and Road Initiative and Lao's economic reform are important research projects, which take the economic corridor of GMS the preparation.

More to these, since the trilateral agreement between Thailand, Lao PDR, and PRC has not yet been enacted, all cargo will continue to be transshipped at the border. This regulatory barrier offers the opportunity for Lao PDR to provide value-added services to the fruit trade such as sorting, grading, packaging, etc. In addition, a clean, refrigerated transshipment space could help improve the quality of the supply chain, thereby increasing product quality and extending shelf life. However, further research is needed to investigate the willingness of consumers to pay for better quality products by using refrigerated containers along the whole process of cold-chain.

At the same time, the investment about the construction of the one-stop window in customs need to be discussed in separate research to confirm the feasibility and possibility.

Lastly, how does SDR with RMB could help stabilize the financial market of Thailand should be studied specifically.

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FOOTNOTE

1 The Greater Mekong Sub-region (GMS) is a natural economic area bound together by the Mekong River, covering 2.6 million square kilometers and a combined population of around 326 million. In 1992, the six countries along the Mekong River– Kingdom of Cambodia (Cambodia), People's Republic of China (PRC), Lao People's Democratic Republic (Lao PDR), the Union of Myanmar (Myanmar), Kingdom of Thailand (Thailand) and the Democratic Republic of Vietnam (Viet Nam)–formed the Greater Mekong Sub-region (GMS) with the launch of the GMS Economic Cooperation Program in order to coordinate improvements in both hard and soft infrastructure.

2 Currently, ADB is developing nine corridors in the GMS: 1) North-South Corridor: Kunming to Bangkok; 2) Eastern Corridor: Kunming to Ca Mau; 3) East-West Corridor: Mawlamyine to Da Nang; 4) Southern Corridor: Dawei to Quy Nhon/Vung Tau; 5) Southern Coastal Corridor: Bangkok to Nam Can; 6) Central Corridor: Kunming to Sihanoukville/ Sattahip; 7) Northern Corridor: Fangcheng to Tamu; 8) Western Corridor: Tamu to Mawlamyine; 9) Northeastern Corridor: Thanh Hoa to Bangkok/Laem Chabang.

3 NSEC consists of three major routes along the north–south axis of the GMS that connect major population and economic centers in the northern and central parts of the subregion, namely, (i) "Western Subcorridor", (ii) "Central Subcorridor", and (iii) "Eastern Subcorridor.

4 Largely parallel, from Bangkok to Chiang Mai (Thailand), section planned parallel from Chiang Rai (Thailand) to Menyang (Yunnan Province of PRC) and again from Mo-Chiang to Kunming (partly under construction).

5 Bangkok (Thailand): Connection from Tak (Thailand) to Mawlamyine (Myanmar) or Bangkok (Thailand) to Dawei (Myanmar) might reduce time to Europe.

6 1 Asian Development Bank devised a set of three characteristics that typifies an economic corridor.(i) It covers a small geographical space straddling a transport artery such as a road, rail, or canal.(ii) It emphasizes bilateral rather than multilateral initiatives, focusing on strategic nodes at border crossings between two countries.(iii) It highlights physical planning so that infrastructure development achieves positive benefits. In a national context, the concept is now increasingly used for development programs.

7 The American Heritage Dictionary defines the term as the basic facilities, services, and installations needed for the functioning of a community or society, such as transportation and communications systems, water and power. Infrastructure typically refers to the technical structures that support a society and economy, such as transportation, water supply, wastewater treatment facilities, power grids, flood management systems, and communications (internet, phone lines, and broadcasting).

8 Harmonization of Financial Practice and Infrastructure, regional Mechanisms for Macroeconomic Oversight, Regional Mechanisms for Financial Stability Oversight and Global Financial Crisis as a Spur to Asian Integration.

9 1 R9: Bangkok –Mukdahan - Laos - Savannakhet - Dan Savan - Lao Bao - Hanoi - Nanning - Chongqing.

10   http://www.scbeic.com/stocks/extra/6615_20131113112051.pdf

11   http://www.ynxxb.com/content/2012-7/13/N98657949241

12   Likert's Scale: Mean 4.21-5.00 (strongly agree); Mean 3.41-4.20 (agree); Mean 2.61-3.40 (neutral); Mean 1.81-2.60 (disagree); Mean 1.00-1.80 (strongly disagree) A regional logistics system, like any other macro-logistics system, is composed of (i) shippers, traders, and consignees; (ii) public and private sector logistics service providers; (iii) provincial and national institutions, policies, and rules; and (iv) transport and communications infrastructure (Banomyong et al. 2007).

13   Grey correlation analysis can quantitatively explain the uncertain relative situation during objects or the relative situation of system factors and main act ion which changes with time. It analyzes and confirms the influence degree of factors according to the geometry approach degree of behavior actor list and data list, that is t o say, it compares them according to the similar degree of data list geometric relation a nd curves geometric shape, so takes the similar degree of curves as the weigh yardstic k of correlation degree.

14   They are Ms. Wan Chongju from Yunnan Traditional Medicine Institute, Kunming; Mr. Lv Jun, Ms. Weng Wei and Mr. Yang Yang from Kunming University of Science and Technology (KUST); Ms. Liu Lingling, Ms. Xu Xiangjin and Mr. Li Jing from Oxbridge College, KUST, Kunming, Mr. Zuo Xiaoming from Jinan University, Guangzhou, Mark Chen from South China Normal University, Guangzhou, China, Mr. Su Ming and Ms. Xu Mingxia from Guangdong International Studies of

Foreign languages; Ms. Zhang Shunan, Ms. Zhou Mei, Ms. Duan Shuting and Ms. Li Jinjin from Yunnan University, and Ms. Ma Li from Yunnan Normal University.

15   The four professors are Mr. Liu Rongda from School of Logistics and Supply Chain, Naresuan University, Ms. Huang Wenjuan and Mr. Liu Chang from Qiang Mai University and Mr. Zhiang Hann from Ransit University.

16   Chinese companies are 10 branches of H&T International Logistics, Guangdong, Lufthansa Freight, Guangzhou and Shenzhen Branch, Guangzhou, COSCO Logistics (Kunming), Ltd and COSCO Logistics (Guangzhou), COSCO Logistics (Xian), Bondex Logistics in Xian, Guangzhou, Foshan, Liuzhou, and Shenzhen branches, and the six companies in Thailand are Uni-inter Forwarding Corp., Fahsai Inter Co. Ltd. and Kunpeng Legal Corp. Ltd. Bondex Logistics (Bangkok Branch), JC Trans Corp. Ltd (Bangkok) and STO Express (Bangkok) Corp. Ltd.

17   There are four stages of corridor development: Transport corridor: Corridor that physically links an area or region; Multimodal corridor: Corridor that has more than one mode of transport that can physically link the corridor, i.e., road and rail; Logistics corridor: Corridor that not only physically links an area or a region but also harmonizes the corridor's institutional framework to facilitate efficient flow and storage of freight, and movement of people and related information and Economic corridor: Corridor that attracts investment and generates economic activity along the less-developed areas in the corridor; requires physical links and institutional framework. (Source: Ruth Banomyong, Logistics Development Study of the GMS North–South Economic Corridor, 2008.)

18   *Thailand–Lao PDR:* MOU between the Government of the Kingdom of Thailand and the Government of Malaysia, Agreement Between the Government of the Kingdom Thailand and the Government of the Lao People's Democratic Republic on Road Transport, 1999 and Subsidiary Agreement Specifying Road Transport Arrangement between the Government of Thailand and the Government of the Lao PDR, 2001.

19   CBTA covers the removal of non-physical barriers to the cross-border movement of people, vehicles and goods, including (i) single-stop, single-window inspection; (ii) cross-border movement of people; (iii) transit traffic regimes; (iv) eligibility requirements for vehicles making cross-border sorties; (v) exchange of

commercial traffic rights; and (vi) related infrastructure such as road and bridge design standards, road signs, and signals (ADB, 2010).

20   Office of The National Economic and Social Development Board. Available at http://www.nesdb.go.th/nesdb_en/main.php?filename=develop_issue

21   Except China, the Mekong-Japan Cooperation Framework and the US-Lower Mekong Initiative (US-LMI) has been undertaken by Japan and the USA to connect with this subregion. Also, Myanmar's policy of opening the country has attracted the attention of the superpowers, in particular the Dawei deep seaport infrastructure megaproject.

22   The SREB/MSR project with its land and maritime path components promises to better connect China with the Middle East, Africa and Europe through its landlocked neighbors in Central Asia and the littoral states of Southeast and South Asia. It spreads the risk by multiplying access routes, thus reducing China's vulnerabilities. The system of ports, railways and roads, which have variously been completed, or are under construction or being proposed, will enable China to diversify the routes by which it can secure the transport of oil and gas and other essential goods needed to sustain China's economy. It enhances the country's energy and economic security and mitigates the risks attendant to transporting fuel and goods through unstable, unsecured or unfriendly channels. For instance, the establishment or proposed establishment of transport corridors via Pakistan (through the Chinese-operated Gwadar Port, and then by proposed railway to link the Sino-Pakistani-built Karakoram Highway and ultimately western China), Myanmar (through the Kyaukphyu Port then through the railway and pipeline to Yunnan, which are under construction) and Thailand (through the proposed Chinese-funded Kra Isthmus project) will enable China to reduce its dependency on the Strait of Malacca chokepoint. Developing pipelines to get oil and gas directly from Russia and Central Asia to power western China also reduces its reliance on the volatile Middle East. (Source: http://thediplomat.com/2015/02/chinas-one-belt-one-road-to-where/)

23   http://countrystudies.us/laos/96.htm

24   E-commerce (electronic commerce or EC) is the buying and selling of goods and services, or the transmitting of funds or data, over an electronic network, primarily the internet. These business transactions occur either as business-to-business,

business-to-consumer, consumer-to-consumer or consumer-to-business. The terms e-commerce and e-business are often used interchangeably. http://searchcio.techtarget. com/definition/e-commerce

25   http://mt.sohu.com/20161209/n475448197.shtml

26   B2C is the smaller category of e-commerce at about one-tenth of all e-commerce. Business-to-Business (B2B) transactions are estimated to make up 90% of e-commerce, but data is more limited.

27   Information and communications technology (ICT) is an extended term for information technology (IT) which stresses the role of unified communications [1] and the integration of telecommunications (telephone lines and wireless signals), computers as well as necessary enterprise software, middleware, storage, and audio-visual systems, which enable users to access, store, transmit, and manipulate information.(Source:https://en.wikipedia.org/wiki/Information_and_ communications _technology)

28   ADB (2011) suggests some sectors and subsectors relevant to all the NSEC routes for good opportunities for investment in Agriculture and agro-industry, resource-based industries, light manufacturing industries, construction materials, agricultural machinery and equipment, technology-intensive industries service-based industries, and cottage industries.

29   Office of The National Economic and Social Development Board. Available at http://www.nesdb.go.th/nesdb_en/main.php?filename=develop_issue

30   The Asian Infrastructure Investment Bank (AIIB) is a new multilateral financial institution founded to bring countries together to address the daunting infrastructure needs across Asia. Through our investments, we strive to promote interconnectivity and economic development in the region through the development of infrastructure and other productive sectors. We believe that the development and improvement of productive infrastructure encourages economic growth, promotes employment, enables business activity and contributes to poverty reduction by providing improved access to basic services, including reliable electricity supply, efficient transport systems, clean water supply, access to sanitation services, and modern telecommunications. (Source: https://www.aiib.org/en/about-aiib/index.html)

31   https://en.wikipedia.org/wiki/Asian_Infrastructure_Investment_Bank

32   The bank has 50 member states (all "Founding Members") and was proposed as an initiative by the government of China. The initiative gained support from 37 regional and 20 non-regional Prospective Founding Members (PFM), all of which have signed the Articles of Agreement that form the legal basis for the bank. The bank started operation after the agreement entered into force on 25 December 2015, after ratifications were received from 10 member states holding a total number of 50% of the initial subscriptions of the Authorized Capital Stock. (Source: https://www.aiib.org/en/about-aiib/index.html)

33   There are also strategic, political and security implications that participating countries would also be advised to consider. (source: http://thediplomat.com/2015/02/chinas-one-belt-one-road-to-where/)

34   Source: http://www.icbc.com.cn/ICBC/Corporate%20BankingClearing% 20and%20Settlement%20Service/CrossBorderRMBSettlement/

35   The SDR is an international reserve asset, created by the IMF in 1969 to supplement its member countries' official reserves. As of March 2016, 204.1 billion SDRs (equivalent to about $285 billion) had been created and allocated to members. SDRs can be exchanged for freely usable currencies. The value of the SDR is currently based on a basket of four major currencies: the U.S. dollar, euro, the Japanese yen, and pound sterling. (Source: http://www.imf.org/external/np/exr/facts/sdr.htm/)

36   The two main criteria for SDR inclusion are (1) share in global exports and (2) currency is "freely usable" (as defined by the IMF). China clearly meets the first criterion as its share of total global exports in 2014 amounted to 12.5%, surpassing the US' 9%. The question on the "freely usable" criterion remains under debate, although we believe that given the progress that China has made towards currency liberalization. (Source: http://en.nikkoam.com/articles/2015/07/the-implications-of-the-rmb-inclusion-in-the-imf-sdr)

37   By January, 2010, the China-ASEAN Free Trade Area (CAFTA) comes into being. 90 percent of trade products will achieve the zero tariff target and substantially open the service trade market. (Source: http://en.people.cn/90001/90778/90861/67893 65. html)

38   http://www.investorwords.com/9555/efficient.html

APPENDIX

APPENDIX A   A SAMPLE AND INTERVIEW

Interview

Dear Sir or Madam,

Thank you for cooperation for this interview.

I am Ms. Xia Yuanchun, a PHD candidate in School of logistics and supply chain, Naresuan University, Thailand. I am making a research titled as *Efficient Transportation Connectivity between Thailand and Yunnan along North South Economic Corridor of GMS*, thus I need your kind help for the qualitative analysis for the logistics performance and potentials of this corridor.

Your kind suggestion and help are highly appreciated.

Notes:

1. Please mark "√"for the answer you choose. And you can choose answers more than 2 except the first question in Part I and Part II.
2. NSEC: the main passage from Kunming to Bangkok in North South Economic Corridor of GMS

Part I: Logistics Performance

1. How do you evaluate the logistics performance along NSEC?

   A. Efficient   B. Far from efficiency.

   (If you choose A for the above question, please turn to questions in Part II directly)

2. The less efficiency of the clearance along this corridor are mainly because_____(you can choose answers more than 2)

   A. Bureaucratic cost are too high;

   B. Informal and unexpected charges occur frequently;

   C. The procedures are too complex and not fixed;

D. The documents required are too much;

E. The governmental officers are far from proficient in operation;

F. The operation and coordination capabilities between customs brokers and transport operators are not satisfied;

3. The less efficiency of the clearance occurs at _____part(s)

A. Yunnan, PRC   B. Lao, PDR   C. Thailand

4. The transport quality in time is not good due to_____ (you can chose none of them if you believe the transport quality in time is good enough)

A. long time waiting for customs clearance;

B. long time waiting for transshipment;

5. The most unacceptable part of logistics charges relies on_____.

A. road transport freight;

B. transshipment charge at border crossing;

C. informal charge for customs clearance;

D. warehousing;

E. Others. (If necessary, please write down below)

6. _____are also the reason(s) for the less efficiency or satisfaction of the transportation.

A Tracking the shipment cannot reach to the real-time tracing;

A. The crossing borders are not in good order and lack of sound management;

B. The road condition is not good;

C. The logistics facilities and equipment are too old or broken;

D. Damages to goods from careless loading and unloading;

E. Un-unified logistics standards among members;

F. Languages' barriers;

G. Others. (If necessary, please write down below)

7. ____are the solutions to the above problems.

    A. Simplifying the customs procedures;

    B. Implementation of CBTA(Cross Border Transportation Agreement among GMS members)

    C. Transport cargo in containers;

    D. Alliance of logistics companies or transport operators;

    E. Improvement of competence of the local logistics industry;

    F. Reasonable distribution of benefits for members;

    G. Sustainable maintenance of the road condition with sustainable investment;

    H. Advanced IT infrastructure.

    I. Others. (If necessary, please write down below)

8. What is the key solution with the first priority in above mentioned items?

    A.   B.   C.   D.   E.

    F.   G.   H.   I.

Part II: Potentials of NSEC

1. Has the potentials of the corridor fully exploited?

    A. Yes.   B nearly 80%   C. about 50%   D less than 30%

2. What are the influencing factors, except the GDP, population and road freight tonnage in both Thailand and Yunnan as well as their trade value, for freight volume?

    A. International financial stability;

    B. Trade complementary and competitiveness between Thailand and Yunnan or PRC;

    C. Emergent issues or changes in political or economic situation in all members;

    D. The improvement of road conditions;

    E. The transparency and efficiency of customs clearance;

    F. Unified logistics standards and operations.

    J. Others. (If necessary, please write down below)

3. What would be the future of this corridor in logistics development?

    A. It will be promising if the current barriers could be removed gradually;

    B. It will be not optimistic.   C. It is hard to predict.

4. What will be helpful to exploit the potentials of this corridor?

    A. Implementation of CBTA.

    B. Border Economic Zones.

    C. Improved IT infrastructures.

    D. E-commerce.

    E. More sources of investment for maintenance and improvement.

    F. Competent associations of logistics industries among members

    G. Less risks for trade settlement.

    H. One-stop service in customs clearance in exporting places.

    K. Others. (If necessary, please write down below)

5. For this research, what is important but has been forgotten in this whole interview?

    (If necessary, please write down below)

    _____

Your Name: _____

Your working place:_____

Your title: _____

End of the Interview.

Thank you again for your very kind

APPENDIX B BENEFITS OF LAO PDR BY SCORE MATCHING

Table 1 Income and Expenditure: After Matching, North–South Economic Corridor, the Lao People's Democratic Republic

Household annual income (KN million)	38.70	23.2	15.50[a]	16.4[a]	15.50[a]
Household annual expenditure (KN million)	28.50	15.5	13.00[a]	5.0	11.20[a]
Share of food in total consumption	46.47	38.5	7.97[a]	6.6[a]	8.76[a]
Percentage of poor households	39.60	47.8	(8.20)[b]	(0.6)	(10.00)[a]

( ) = negative, KN = kip.

a 1% level of statistical significance.

b 5% level of statistical significance.

Source: ADB, Assessing Impact in the Greater Mekong Subregion: An Analysis of Regional Cooperation Projects, 2014

Table 2 Employment Opportunities: After Matching, North–South Economic Corridor, the Lao People's Democratic Republic

Percentage of households who consider farming as their main occupation	73.00	76.0	(3.00)	(7.9)[a]	(8.5)[a]
Percentage of household who have shifted from agriculture to non-agriculture over the last 5 years	13.00	5.7	7.30[a]	4.3[a]	8.3[a]
Percentage of households who consider trading as their main occupation	7.73	7.5	0.02	6.0[a]	3.2[a]
Percentage of households who consider transport provision as their main occupation	1.78	0.7	1.08	0.7	1.1
Percentage of households who consider tourism services as their main occupation	1.78	0.0	1.78[b]	1.8[b]	1.8[b]
Percentage of household operating a family business	36.00	31.0	5.00	10.7[a]	8.7[a]

( ) = negative.

a 1% level of statistical significance.

b 5% level of statistical significance.

c 10% level of statistical significance.

Source: ADB, Assessing Impact in the Greater Mekong Subregion: An Analysis of Regional Cooperation Projects, 2014

Table 3 Livelihood Indicators: After Matching, North–South Economic Corridor, the Lao People's Democratic Republic

Perception of household living standard compared to others in the village (Likert Scale from 1 to 5)	3.140	2.840	0.300*	0.300*	0.300*
Households who perceive improvement in their livelihood over the past 5 years*	0.750	0.720	0.030	0.009	(0.012)
Households having tiled roof*	0.470	0.380	0.090*	0.090*	0.070*
Households having brick wall*	0.185	0.187	(0.002)	0.035	0.029
Households using modern energy (charcoal, LPG, electricity)*	0.160	0.070	0.090*	0.097*	0.076*
Households using permanent toilet	0.920	0.860	0.060	0.160*	0.090*
Households drinking boiled water	0.920	0.900	0.020	0.060*	0.000

( ) = negative, LPG = liquefied petroleum gas.
Note: * denotes that the variable is a dummy of 1.0 where a household meets the criteria.
* 1% level of statistical significance.
† 5% level of statistical significance.

Source: ADB, Assessing Impact in the Greater Mekong Subregion:An Analysis of Regional Cooperation Projects, 2014

Table 4 Asset and Livestock Ownership: After Matching, North–South Economic Corridor,the Lao People's Democratic Republic

Number of cars per household	0.098	0.068	0.03	0.040	0.04*
Number of motorcycles per household	1.160	0.990	0.17*	0.300*	0.24*
Number of bicycles per household	0.700	0.620	0.08	0.146*	0.15*
Number of TVs per household	0.880	0.770	0.11*	0.150*	0.29*
Number of radios per household	0.640	0.650	(0.01)	0.190*	0.12*
Number of VCDs per household	0.330	0.210	0.12*	0.060	0.05
Number of fans per household	1.250	0.650	0.60*	0.650*	0.65*
Number of cattle per household	2.520	0.720	1.80*	1.500*	1.60*
Number of poultry per household	21.630	23.910	(2.27)	0.950	(1.80)

( ) = negative.
* 1% level of statistical significance.
† 5% level of statistical significance.
‡ 10% level of statistical significance.

Source: ADB, Assessing Impact in the Greater Mekong Subregion:An Analysis of Regional Cooperation Projects, 2014

Table 5 Time to Access Various Services: After Matching, North–South Economic Corridor, the Lao People's Democratic Republic (minutes)

School	10 52	16 16	(6)[a]	(4.8)[a]	(5.0)[a]
Hospital	24 200	108 122	(84)[a]	(82)[a]	(132.0)[c]
Market	29 48	184 185	(155)[a]	(150)[a]	(127.0)[a]
Bank	18 366	24 20	(6)[a]	(7)[b]	(13.4)[c]

( ) = negative.

Note: Numbers in *italics* refer to the situation 5 years ago.

[a] 1% level of statistical significance.

[b] 5% level of statistical significance.

[c] 10% level of statistical significance.

Source: ADB, Assessing Impact in the Greater Mekong Subregion: An Analysis of Regional Cooperation Projects, 2014

Table 6 Service Access or Usage: After Matching, North–South Economic Corridor, the Lao People's Democratic Republic

Share of households selling goods in a provincial market[d]	0.13	0.18	(0.05)[c]	(0.070)[a]	(0.050)[c]
Share of households selling goods along the road[d]	0.09	0.10	(0.01)[a]	(0.030)	0.005
Share of households selling goods in the village[d]	0.29	0.45	(0.16)	(0.100)[a]	(0.150)[a]
Share of rice sales in total rice production[d]	0.10	0.32	(0.22)[a]	(0.220)[a]	(0.210)[a]
Share of vegetable sales in total vegetable production[d]	0.18	0.17	0.01	(0.010)	0.020
Share of fruit sales in total fruit production[d]	0.054	0.068	(0.014)	(0.011)	(0.003)
Share of households accessing microfinance[d]	0.15 0.07	0.23 0.13	(0.08)[a]	(0.074)[a]	(0.08)[a]
Share of households accessing a bank[d]	0.26 0.16	0.36 0.14	(0.1)[a]	(0.090)[a]	(0.08)[c]

( ) = negative.

Notes: Numbers in *italics* refer to the situation 5 years ago. [d] denotes that the variable is a dummy of 1.0 where that a household has used the service.

[a] 1% level of statistical significance.

[b] 5% level of statistical significance.

[c] 10% level of statistical significance.

Source: ADB, Assessing Impact in the Greater Mekong Subregion: An Analysis of Regional Cooperation Projects, 2014

APPENDIX C BENEFITS OF YUNNAN PROVINCE BY SCORE MATCHING

Table 1 Income Comparison, North–South Economic Corridor, Yunnan Province

Log of total income	Unmatched	9.739980	8.995257	0.744724	0.073020	10.20
	Matched	9.335077	9.329565	0.005511	0.225117	0.02

Source: ADB, Assessing Impact in the Greater Mekong Subregion:An Analysis of Regional Cooperation Projects, 2014
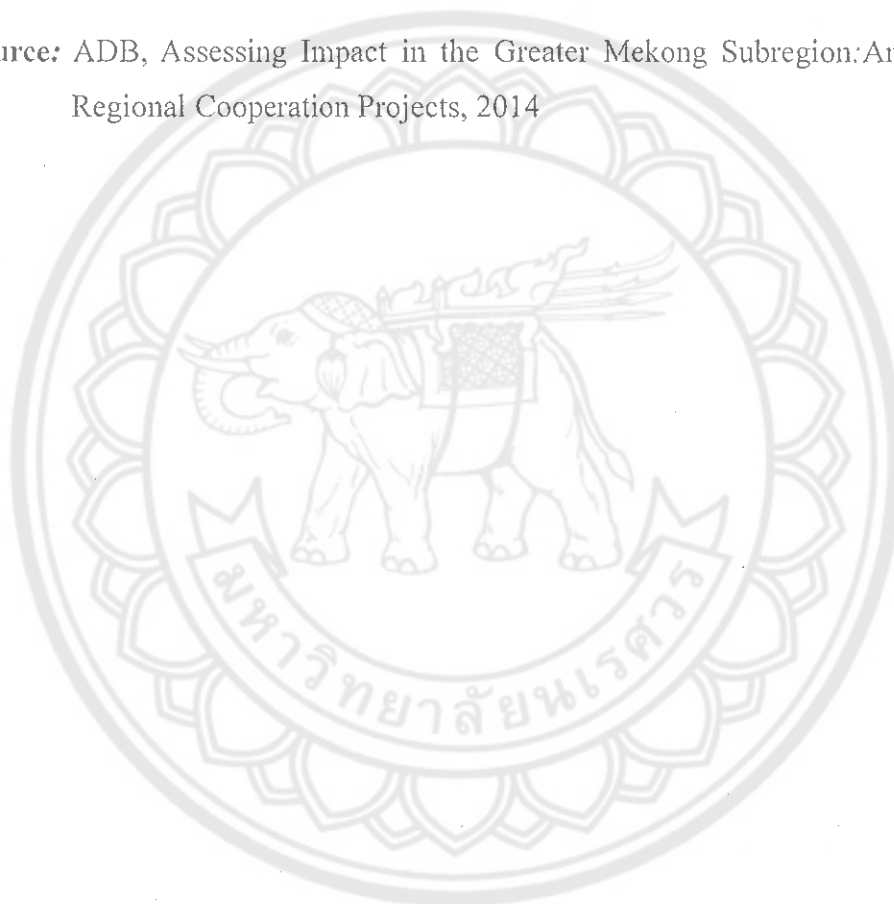
Appendix D BENEFITS OF THAILAND BY SCORE MATCHING

Table 1 Income and Debt: After Matching, North–South Economic Corridor, Thailand

Income				
Household income	0.234355	(0.1090992)	0.3527265	0.2305303
	0.2026	*0.3221*	*0.3064*	*0.2051*
Proportion of households with increasing income in the past 3 years	0.0119462	0.1033254	(0.0255866)	(0.0059585)
	0.0568	*0.0891*	*0.0623*	*0.0767*
Proportion of households with debt	0.111443	0.1515669	0.1116224	0.1113277
	0.0567	*0.1116*	*0.0559*	*0.0576*

( ) = negative.

Note: Numbers in *italics* are t ratios.

Source: ADB, Assessing Impact in the Greater Mekong Subregion: An Analysis of Regional Cooperation Projects, 2014

Table 2 Types of Expenditure: After Matching, North–South Economic Corridor, Thailand

Investment in agricultural sector	0.0987039c	0.026359	0.140516c	0.0990676
	0.0578	0.1169	0.0540	0.0839
Investment outside agricultural sector	(0.0262482)	(0.0790145)c	(0.0128057)	(0.0068344)
	0.0294	0.0343	0.0231	0.0317
Consumption	(0.0042365)	0.0481142	(0.0215068)	(0.0257556)
	0.0471	0.1973	0.0563	0.0527
Education	0.0403233	0.0586789	0.0309686	0.1227467c
	0.0555	0.1096	0.0605	0.0517
Healthcare	0.0108163	(0.0209932)	(0.0074016)	0.0340801
	0.0296	0.0866	0.0333	0.0276
Debt repayment	(0.0092568)	(0.0704668)	0.0148844	(0.0142531)
	0.0440	0.1262	0.0563	0.0539
Savings and Insurance	0.0235439	0.102869a	0.0059398	0.0610177c
	0.0272	0.0322	0.0307	0.0284
Others	0.0069243	0.0119044	(0.0028846)	0.0012616
	0.0067	0.0132	0.0108	0.0079

( ) = negative.

Note: Standard errors are in italics.

a 1% level of statistical significance

b 5% level of statistical significance

c 10% level of statistical significance

Source: ADB, Assessing Impact in the Greater Mekong Subregion: An Analysis of Regional Cooperation Projects, 201

BIOGRAPHY

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