REGIONAL TRANSPORTATION INFRASTRUCTURE CONNECTIVITY: THE CONCERNS ON THAILAND'S CBTI FACILITIES DEVELOPMENT

by

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ABSTRACT

The collaboration of policy development among the neighboring countries and seamless physical integration between the boundaries are the significant attributes of these days' global logistics and transportation infrastructure development. These connectivity attempts give precedence to the cross-border transportation infrastructure (CBTI). Based on the investigation of the agreement with the state of Thailand's CBTI facilities, the country that serving as a transportation hub and transitional country throughout the Southeast Asia countries, the principal stakeholders' concerns toward the development of land transportation are identified and discussed. These results provide salient information to the companies or organizations that interested to join and searching for the business opportunities, particularly from Southeast Asia, the region that recognized as one of the most fast growing economies in Asia.

KEYWORDS
Cross-Border Transportation Infrastructure, Regional Transportation Infrastructure, Southeast Asia, Thailand

INTRODUCTION

Asia is one of the most significant contributors to the global production network and supply chain (Kuroda, 2006). Certain studies regarding Southeast Asia, particularly on China, Cambodia, Laos, Myanmar, and Vietnam, have reported that this region is attractive to foreign investors (Ta *et al.*, 2000 and Goh and Ang, 2000). However, the reduction of transport and logistics costs, the connection of production clusters in different countries and the linkage of these clusters with the market are future production network and supply chain challenges that will be addressed in the next few decades (Kuroda, 2006).

Cross-border transportation infrastructure (CBTI) development, which is a combination of cross-border hard infrastructure and related software (ADB, 2006), is introduced. It ideally increases cross-border trade and cooperation and integration of regions. For Southeast Asia, Thailand, one of the fast growing economies in Asia has been recognized as having a favorable geographical position (Yoshida, 2001; Krongkaew, 2004; and Murshid, 2005) for serving as a transportation hub and transitional country, especially for cross-border transportation. Therefore, investigating the capability of Thailand's CBTI is salient, which it would facilitate region's connecting processes as well as the operation and implementation of the logistics and transportation businesses.

This paper aims to identify and discuss the concerns of principal stakeholders, user and developer/regulator of this transport system, toward the capability of cross-border hard infrastructure and relevant software. To identify such the concerns, the factor analysis is employed. Moreover, this paper particularly focuses on land (road) transportation modes. It examines the specific elements within the 4 dimensions (constructs): quantity- and quality-related, effectiveness- and efficiency-related, system- and standard-related, and policy- and measure-related.

LITERATURE REIVEW

Definition of CBTI

Japan International Cooperation Agency (JICA) (2006) has defined cross-border transportation as the transportation across international boundaries and CBTI as the basic infrastructure that allows and facilitates cross-border transportation. In addition, Henderson and McGloin (2004) have defined CBTI as the establishment of physical assets that have a cross-border element, for example, construction partners that are from different jurisdictions or a project output that straddles the border region.

For this paper, cross-border transportation is defined as the "transportation of people or goods from one point of origin to the point of destination that crosses international boundaries regardless of whether using unimodal or multimodal transportation or handling of goods." CBTI is used to indicate the basic infrastructure that allows for and facilitates these specific cross-border transportation attributes. Moreover, cross-border transport includes both transport across boundaries to adjacent countries and transitions to neighboring countries of the adjacent countries.

Context of CBTI

Some of the previous surveys and studies indicated that an inefficiency in an international logistics operation and management processes, such as an unwelcoming environment, policy, regulation, procedures and standards, and customs and trade difficulty are impediments that must be addressed to promote the movement of people, services, and goods (Goh and Ang, 2000; Goh and Ling, 2003; and Kuroda, 2006). Correspondingly, JICA (2006) proposed that CBTI development not be limited to physical infrastructure, such as transport facilities, but instead that it extends over a wide range of areas, covering non-physical and soft infrastructure. The 4 key elements that form the CBTI are listed and described as follow:

'Mode of transportation/facilities': transportation facilities (e.g. roads and ports) and mode of transportation (e.g. railways),

Hub facilities': cross-border facilities and transshipment facilities that transportation passes through,

Systems/standards': establishment of various systems (e.g. immigration system and organization framework), and

'Operation/management': operation and management of mode of transportation, facilities, and hub facilities.

In the present study, the key dimensions (constructs) are considered: quantity- and quality-related (which assesses the first two key elements), effectiveness- and efficiency-related (which assesses the fourth key element), and system- and standard-related dimensions. According to the above researchers' concerns, the policy- and measure-related dimension has also been added into the study. Thus, 47 elements measuring different dimensions of the CBTI's capability were identified and collected from relevant papers of these following authors: Li, 2000; Speece, 1995; Goh and Ang, 2000; Goh and Ling, 2003; Nollet et al., 1994; Fawcett et al., 1995; Taylor, 1995; Ta et al., 2000; Rydzkowski, 1993; Persson and Beckman, 1993; Kunadhamraks and Hanaoka, 2008. Brief descriptions of these elements are given in Table A-1. The letter given for each element indicates its corresponding dimension.

RESEARCH METHODOLOGY

This study is based on a questionnaire survey used to determine agreement with the state of Thailand CBTI facilities. A five-point scale questionnaire was used to assess the respondents' agreement. The scale ranged from 1 to 5 with the following designations: 1 = strongly disagree, 2 = somewhat disagree, 3 = uncertain, 4 = somewhat agree, and 5 = strongly agree. Values from this survey were used to conduct factor analysis.

The targeted sampling groups consisted of a group of users and a group of developers and regulators for land transportation mode. An opinion of these groups is salient since their concerns and requirements would influence the initiation, improvement, development, and operation of this transport system. A stratified random sample technique was applied to select the samples. The first group samples were drawn from the registered members of logistics, transportation, or freight forwarder associations. The second group samples were obtained from government, state-owned, and academic offices involved in the development or regulation of these transportation modes. The respondents were asked to provide their agreement opinions regarding the states of each mode of transportation. In total, 82 completed questionnaires were used to obtain quantitative data, in which 39% (32 questionnaires) and 61% (50 questionnaires) were from the first and second sample group, respectively.

Statistical method

Factor analysis

Factor analysis (principal component analysis) is a technique for identifying groups or clusters of variables. Excepting to the main uses of factor analysis that is to reduce a dataset to a more manageable size while retaining as much of the original information as possible (Field, 2005), it describes the meaning of each factor corresponding to the elements that belonged or extracted to such factor (Wanichbancha, 2009). The first factor explains the highest proportion of observed variance in the dataset. The second factor accounts for the majority of the variance not explained by factor 1 and so on (McDade and Adair, 2001). In other words, the first factor is the cluster of the elements that the respondents most agreed they are well developed or performed efficiently. Therefore the last factor contrarily is the group of the elements that least agreed. There are certain main stages of factor analysis:

1. Initial solution: The Kaiser-Meyer-Olkin (KMO) and Bartlett's tests of sphericity are conducted in this stage. The KMO statistic varies between 0 and 1. A value close to 1 indicates that the correlation patterns are relatively compact so factor analysis should yield distinct and reliable factors. Field (2005) stated that a KMO value of .5 is recommended as barely acceptable, values between .5 and .7 are mediocre, values between .7 and .8 are good, values between .8 and .9 are great, and values above .9 are superb. For the Bartlett's tests of sphericity, Ocal *et al.* (2007) suggested that the test should show that the correlation matrix is not an identity matrix by giving a significance value smaller than .001. The Cronbach's coefficient alpha (α) was also employed to check the questionnaire reliability. α values ranging from ~.7 - .8 are acceptable (Field, 2005).

2. Extracting the factors: A number of components (factors) are extracted from the correlation matrix based on the initial solution. In this paper, the author chose to retain a fixed factor because there are 4 constructs underlying the survey questions: quantity- and quality-related, effectiveness- and efficiency-related, system- and standard-related, and policy- and measure-related. The variables cluster into each factor, as defined by the factor loadings, where high loading values imply that the factors and variables are critical. The terms 'strong', 'moderate', and 'weak' refer to absolute loading values of >.75, .75-.5, and .5-.3, respectively (Liu *et al.*, 2003). Additionally, Ghosh (2004) stated that for the percentage of variance approach, all of the extracted factors should account for at least 60% of the total variance.

3. Rotating the factors: This process clarifies the variables relating to each factor by changing the absolute values of the variables while maintaining their differential values constant (Field, 2005). The commonly used 'Varimax" method was selected for this study.

4. Naming the factors: Typically, after deriving the results, by analyzing the factor loading of each variable, appropriate names are given to each factor. However, this process is not used in this study.

5. Internal consistency analysis: A Cronbach's α analysis will be applied to test the internal consistency among the elements for each factor. A α value of .7 - .8 is expected, which ensures that the factor is reliable.

ANALYSIS AND RESULTS

Factor analysis

Initial solution

Factor analysis was initially performed on all 47 elements (variables). To examine the appropriateness of using factor analysis, the KMO and Bartlett sphericity tests were applied. As shown in Table 1, the results were satisfactory for the datasets. The KMO values for land transport were .780, which are considered as good. Moreover, the Bartlett sphericity tests for the variables within the dataset indicated high correlations (the test results were significant (<0.001)) providing a reasonable basis for factor analysis. Additionally, the table shows the Cronbach's α value, which is greater than the acceptable level, ensuring that the questionnaires are reliable.

TABLE 1
KMO AND BARTLETT TEST RESULTS AND CRONBACH'S ALPHA VALUES

		Land transport
KMO Measure of Sampling Adequacy		.780
Bartlett's Test of Sphericity	Approx. Chi-Square	3164.525
	Df	1081
	Sig.	.000
Cronbach's α		.971

Extracting and rotating factors

Table 2 includes selected statistics for the extracted factors, i.e., extracted communality, initial and rotation eigenvalues, and factor loading. The extracted communality indicates the variance of each variable that is accounted for by the extracted factor (Gerber and Finn, 2005). As shown in the table, B5_Worth has the lowest communality (.174). The initial eigenvalue, factor 1, which has a variance of 20.515, accounted for 43.649% of the total variance of all elements. On the other hand, the last factor has a variance of 2.123, accounted for only 4.516% of the total variance of all elements. Thus the factor 4 has the least effect in explaining the capability of the CBTI. With the fixed 4-factor specification, the cumulative percentage of variance is 62.002%, indicating that these factors explain ~62% of the variability in the original variables.

Identifying the concern of CBTI facilities development

As shown in Table 2, only factor loadings greater than +.4 are demonstrated. Factor 4, which accounts for the lowest proportion (~5%) of the total variance, has a moderate loading, marked by (††), on the element in the quantity- and quality-related and effectiveness- and efficiency-related dimensions (A1_Quant through A5_DoLik and B1_CuCap, respectively). Thus, these elements in the corresponding two dimensions least efficiently support the operation and implementation of cross-border transport. Factor 3, which accounts for ~6% of the total variance, has a loading on the elements in the effectiveness- and efficiency-related dimension. Moderate loading occur on B14_TeAp through A23_BrTe, except for A19_LoMi that has a weak loading. For B5_Worth, no extraction occurred due to its low communality. All α values are greater than .85 (see Table 2), indicating good reliability.

TABLE 2
EIGENVALUES AND FACTOR LOADINGS FOR THE ROTATED FACTORS

Element (consideration)	Component (factor)				Extracted Communality
	1	2	3	4	
Initial Eigenvalues	20.515	3.785	2.718	2.123	
% of Variance	43.649	8.054	5.785	4.516	
A1_Quant				.721††	.561
A2_SiDim				.867†††	.797
A3_Quali				.748††	.781
A4_Locat				.723††	.677
A5_DoLik				.633††	.667
A6_IntLk	.592††			.413	.661
A7_Acces	.692††				.591
A8_AuxFa	.727††				.743
A9_Avail	.635††			.477	.689
A10_Modn	.747††				.742
B1_CuCap	.480			.638††	.690
B2_FuCap	.529††			.490	.596
B3_AdCap	.674††				.620
B4_Densi	.479†	.403			.542
B5_Worth					.174
B6_TCons	.641††		.426		.688
B7_TPred	.685††				.684
B8_CReas	.643††		.442		.659
B9_CPred	.592††				.577

B10_ChAv	.639††				.606
B11_Serv	.654††				.652
B12_AcAl	.626††				.698
B13_Divs	.543††		.465		.588
B14_TeAp			.631††		.561
B15_Trap	.508		.643††		.729
B16_Solv	.435		.574††		.589
B17_Mult	.457		.501††		.497
B18_InfA			.793†††		.708
B19_LoMi			.499†		.378
B20_TfAo			.586††		.520
B21_Comp			.671††		.515
B22_DpMi			.642††		.498
B23_BrTe		.429	.535††		.520
C1_FaSta		.640††			.657
C2_SfSta		.789†††			.749
C3_DoSta		.803†††			.674
C4_ScSta		.786†††			.727
C5_OpSta		.775†††			.696
C6_OpLeg		.717††			.616
C7_CmLeg	.403	.766†††			.812
C8_LegAm		.574††	.491		.656
D1_FaImp		.756†††			.637
D2_FiAll		.599††			.593
D3_ColSk		.625††			.517
D4_EnvFr		.593††			.436
D5_Facil	.448	.541††			.571
D6_UtMov	.491	.554††			.603
Rotated	9.152	8.570	6.381	5.039	
% of Variance	19.472	18.234	13.576	10.721	
Cronbach's α	.955	.945	.903	.898	

Note: Extraction method: principal component analysis.
Cumulative % of variance is 62.002
† = Weak loading; †† = Moderate loading; ††† = Strong loading

CONCLUSION AND SOME IMPLICATION FOR OPERATION, IMPLEMENTATION AND DEVELOPMENT OF CBTI

Factor analysis can be used to identify the most and least efficient elements of Thailand's CBTI by identifying groups or clusters of variables that, respectively, retain as much and less of the original dataset as possible. It identifies the general trends in the data, which discovers the unexpected relationships that may challenge/insight the CBTI operation, management, and development. The first group (factor) accounts for the largest part of the total variance of the cases. Contrarily, the last group accounts for the smallest part of the datasets. This tool was applied to datasets derived from an investigation of developer/regulators' and users' agreements with the state of the CBTI facilities for land transportation mode. Within the extraction processes, the 4 fixed factors were specified based on 4 constructs underlying the survey questions. The results for land transport showed that the quantity- and quality-related dimension, especially on its physicalness such as the total highway length, highway width, number of bridges, condition of highways and bridges, and its locations and linkages, is the least efficient component in the CBTI. In other words, the users, developers, and regulators who involved with this transport mode are concerned about these elements. Moreover, the anxiety is also found on the ability or competency of person who operates or implements such facilities.

Based on the findings, the continuous improvement and development of these transportation facilities for example, initiating new transportation routes, increasing the capacity and quality of the existing facilities, connecting those new and existing transportation routes, and improving their accessibility and availability are compulsory. In this regard, the government can boost the state of these improvement and development through the national policy and plans. Furthermore, the competency and manners of person who involved in the operation of these transportation modes for example, ability to apply and utilizing an advanced technology, ability to solve the encountered problems, the non-bribery, non-extortion, and transparency practices, need to be improved and enhanced. With reference to this concerns, educating and training processes as well as righteous practicing are necessary to be employed and promoted into the industry to delivery the real professional human resources.

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APPENDIX

TABLE A-1
ELEMENTS USED TO MEASURE CBTI CAPABILITY

Element	Remarks
	Quantity- and quality-related dimension (construct)
A1_Quant	Values for current facilities such as total highway length, number of bridges, number of ports and airports, and number of cargo terminals.
A2_SiDim	Physical aspects of the facilities such as highway width, area of passenger or cargo terminals, water level of waterways, and container yard size.
A3_Quali	Quality or condition of roads, highways, bridges, ports, runways, and waterways.
A4_Locat	Places or areas in which the facilities are located or built.
A5_DoLik	Domestic linkages or connections between highways, roads, air transport, and water transport.
A6_IntLk	International linkages or connections between highways, roads, highways and roads, air transport, and water transport.
A7_Acces	Ability, opportunity and convenience of the users to enter or reach the facilities.
A8_AuxFa	Auxiliary facilities such as the number of traffic lights and signs or visual airfield approach lighting systems.
A9_Avail	Operability or availability of the facilities.
A10_Modn	State of the facilities or up-to-date equipment used in the operations in these facilities.
	Effectiveness- and efficiency-related dimension (construct)
B1_CuCap	Ability of the facilities to serve current demands.
B2_FuCap	Ability of the facilities to serve future demands (next 5 years).
B3_AdCap	Ability of the facilities to adjust to serve future demands.
B4_Densi	Traffic congestion and facility operational area congestion.
B5_Worth	Significance and value of current facilities that are being developed or initiated.
B6_TCons	Appropriateness of time consumption when utilizing such facilities.
B7_TPred	Ability of such facilities' users to accurately predict or forecast their service times.
B8_CReas	Appropriateness and reasonableness of service cost.
B9_CPred	Ability of such facilities' users to correctly predict or estimate their service costs.
B10_ChAv	Probability that the facilities' users will encounter unforeseen changes.
B11_Serv	Ability and flexibility of the facilities to serve users' needs based on factors such as areas of service, number of routes, and service periods.
B12_AcAl	Suitability of the allocated duties and responsibilities.
B13_Divs	Diversity of the service arrangement for the facilities' users based on factors such as types of service and vehicles.
B14_TeAp	Application of new or advanced technology in the operation or service of the facilities.
B15_Trap	Transparency of the agents or organizations engaged in the operation and management of the facilities.
B16_Solv	Ability to handle managerial and operational problems.
B17_Mult	Ability to perform transshipment with other modes of transportation.
B18_InfA	Ability of the facilities' users to access relevant information.
B19_LoMi	Minimization of accidents and cargo damage.
B20_TfAo	Theft, robbery, and extortion avoidance.
B21_Comp	Competency of workforces engaged in the operation or management of the facilities.
B22_DpMi	Dispute minimization.
B23_BrTe	Workforces engaged in the operation and management to eliminate bribery.
	System- and standard-related dimension (construct)
C1_FaSta	Systems and standards for the facilities.
C2_SfSta	Systems and standards for safety enforcement in the operation and utilization of the facilities.
C3_DoSta	Systems and standards for documents related to the operation and utilization of the facilities.
C4_ScSta	Systems and standards of security enforcement in the operation and utilization of the facilities.
C5_OpSta	Systems and standards relevant to the operation and service of the facilities.
C6_OpLeg	Restrictions and/or legislations relevant to the operation and utilization of the facilities.

C7_CmLeg	Legislations related to commercialization.
C8_LegAm	Informing processes of the amendments or deregulations of the regulations or legislations.
	Policy- and measure-related dimension (construct)
D1_FaImp	Policies and measures relevant to the improvement or development of the facilities.
D2_FiAll	Policies and measures relevant to fiscal budget allocations.
D3_ColSk	Policies and measures relevant for seeking collaboration.
D4_EnvFr	Policies and measures regarding environmental friendly practices.
D5_Facil	Policies and measures that facilitate the use of the facilities.
D6_UtMov	Policies and measures that motivate the use of the facilities.