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Applying the Analytical Hierarchy Process (AHP) Approach to Assess an Area-Based Innovation System in Thailand

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ABSTRACT

This paper examines the criteria that is significant in building an area-based innovation system in Thailand. The Analytical Hierarchy Process (AHP) questionnaire was distributed to experts in the area of urban planning, development, and policy studies. They assessed and prioritized indicators that could shape the innovation system on a regional scale. The study found that enhancing human capital, innovation collaboration, innovation capability, cultural/knowledge resources, and innovation capacity is more important, rather than focusing on physical infrastructure development. This implies that major elements for an area-based innovation system in Thailand highly depend on citizen, institutions, and linkages across sectors.

Keywords: *innovation system, area-based development, Analytical Hierarchy Process (AHP), innovation corridor*

INTRODUCTION

According to the Sustainable Development Agenda 2030 or the Sustainable Development Goals (SDGs), underlining the inter-connectedness between economic, social and environmental dimensions, Thailand National Strategy (B.E.2560-2579) and the 12th National Economic and Social Development Plan (B.E.2560-2564) have adopted those concepts and transformed them into a vision comprising of stability, prosperity, and sustainability. Interestingly, innovation has been highlighted as a mechanism in shaping the productivity and innovation-driven society, which is one of the national development goals.

Innovation is defined as the process of implementing new ideas to create value for service, systems, processes, or existing products. Despite being originality based on science and technology, innovation requires placemaking in urban spaces that could serve the processes of creating idea and lifestyles innovators. Area-based innovation becomes a concept that enhances the performance of a knowledge innovative-driven society. An analysis of criteria prompts this research to examine some indicators that could significantly build such a society in Thailand.

Area-based innovation is divided into three scales: region, city, and district. More importantly, there are three components that fundamentally build places: infrastructure, urban development, and people engagement. Table 1 shows that when the scales and the components come together, theoretical concepts occur that frame the study of area-based innovation. However, this paper focuses on the intersection between region and infrastructure that leads to the study of the regional innovation system. This is to gain an insight into the indicators or factors that form the regional innovation system. (Table 1)

In fact, there are many ideas concerning development on a regional scale. Banomyong (2008, 2010), stated that there were four types of regional, so-called corridor, development.

- Transportation corridor: corridor development based on mega infrastructure or transportation network that links the region together
- Multimodal-transportation Corridor: corridor development based on various kinds of transportation modes
- Logistic Corridor: corridor development based on a logistic system that could efficiently support human mobility, goods or services and data transfer across the region
- Economic Corridor: corridor development based on investment.

Banomyong added that the concept was generated in 1998. The Asian Development Bank also pointed out that the concept was based on integrated infrastructure; roads, rails, ports, and airports. They help support economic activities within a country or a region through linkages (Octaviano, 2014).

Nonetheless, an innovation corridor is a new idea for area-based development. It can be defined as a continually developing concept for economic corridors. It aims to enhance economic growth through the exploitation of innovation that requires a prompt system on a regional scale. In this paper, provinces along the Southern East-West Corridor of Thailand[1], approximately 60 kilometers long, were selected as the case study. This area is a central part of the GMS Southern Economic Corridors (EWEC)[2], a major land transport route that connects goods, culture, and knowledge between the Andaman Sea and the Pacific Ocean. Upon the completion of this study, the key criteria that considerably shapes a regional innovation system would be applied. These

Table 1: Theoretical Concepts of Area-based Innovation

	Infrastructure	**Urban Development**	**People Engagement**
Region	Regional Innovation Systems	Growth Pole	Regional Ethnography
City			
District			

Source: Pun-arj Chairatana, 2016

[1] The Southern East-West Corridor of Thailand comprises of Bangkok, Nonthaburi, Pathumthani, Samutprakarn, Samutsongkhram, Samutsakhorn, Nakornpathom, Kanchanaburi, Ratchaburi, Petchburi, Prachinburi, Pranakornsri Ayuthaya, Nakorn-nayok, Prajinburi, Sra-kaew, Chachoengsao, Chonburi, Rayong, Chantabuti, Trad.

[2] The GMS Southern Economic Corridors (EWEC) has a length of 1,320 kilometers, connecting Myanmar - Thailand - Cambodia – Vietnam.

factors would become strategies for area-based development that potentially serves innovators and innovation in Thailand.

Review of Literature

The review of literature is divided into three parts: (A) area-based innovation, (B) innovation corridor, and (C) the Analytical Hierarchy Process (AHP). The initial part defines area-based innovation, provides theoretical concepts and principles of the innovation system. In the second part, innovative corridor cases are referenced. Thereafter, in the Analytical Hierarchy Process (AHP) a selection of the best alternative or criteria for spatial development will be explained.

A) Area-based Innovation

Area-based innovation is one of the major strategies deployed to promote innovation development during B.E. 2560-2563, by the National Innovation Agency (Public Organization) or NIA[3]. Three spatial scales, an innovation corridor or region, an innovation city, and an innovation district were identified. Key programs prompt urban areas to appropriate places for innovative development. The expected output is an inclusive growth based on the following objectives: to promote the development of infrastructure that facilitates the creation of innovative systems, to manage resources for innovation space, and to promote community participation.

The NIA has initially adapted the concept of an area-based innovation system. Such a concept includes these key five elements: physical components, institutions, resources, linkages across sectors, and citizens (Figure 1).

- Physical components mean natural and built environments that promote innovation. The components consist of geographical characteristics, location, mega infrastructure, and local infrastructure.
- Institutions refer not only to organizational bodies but also to the efficiency of management and innovation development within and between institutes. Institutes according to the NIA include organizations at various levels and types; public and private organizations, educational and research institutes.
- Linkage across sectors refers to forward and backward linkages of the manufacturing and services sectors. The linkages could greatly impact economic activities regarding the multiplier and spillover effects on various sectors.

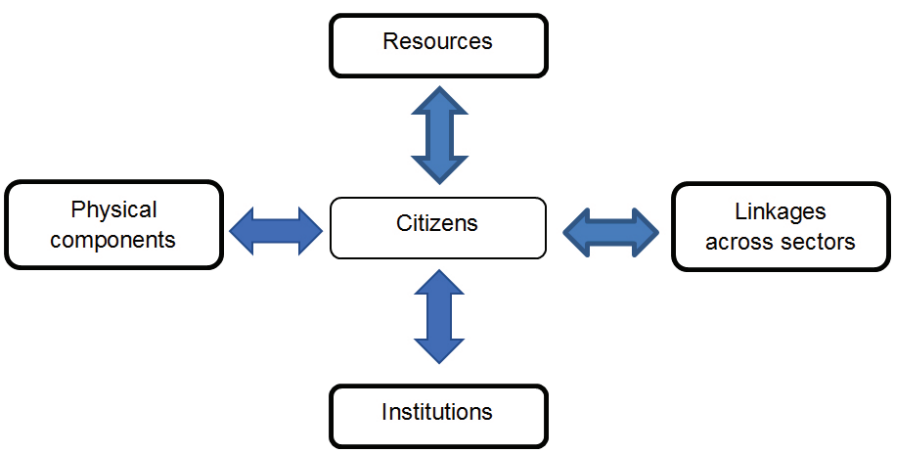

Figure 1:
NIA's concept of innovative system development

[3] The NIA performs as an organization that drives national innovation system to achieve the growth of socio-economic development and the inclusive growth of innovation society.

- Resources mean components that can be exploited for innovative development. These resources comprise both natural resources used for manufacturing and human-made or cultural resources that generate value-added creativity for people and an innovative society.
- Citizens are at the center of an innovative system. This shows a sense of public participation through area-based development processes.

Theoretically, an innovative system on a regional scale is basically related to the 'Triple Helix' concept (Figure 2) developed by Etzkowitz (1993), and Etzkowitz and Leydesdorff (1995). The foundation of an innovation development policy is based on the inter-connectedness between three key bodies; government or public institutions, industries or business sectors, and academic institutions, particularly universities and research units. Nonetheless, Carayannis and Campbell (2009 and 2012), stated that 'citizen' was required to be the fourth component. They added that citizens could be a significant mechanism who drives public participation and sustainable development. Thus, the concept of 'Quadruple Helix' (Figure 3) was created. The model is concerned with social and cultural issues such as the media, industry, creativity, values, values, lifestyles and arts. This may be consistent with the concept of the creative class presented by Florida (2002).

Carayannis and Campbell (2012), also pointed out that there was a close relationship between those two helix models (Figure 4). While the triple helix could primarily enhance knowledge concerning innovation, the quadruple helix could considerably build on the societal knowledge which is the foundation of a knowledge economy and democracy. Thus, comparing the NIA's concept of an innovation system development (as shown in Figure 2) to the quadruple helix model (as shown in Figure 4), two interesting issues can be noted. First, within the context of Thailand, natural resources along with physical infrastructures are mentioned; they seem to be the fundamental requirements that shape the environment of an innovation system. Second, the helix models emphasize intangible bodies; the key institutions, people engagement and interaction between them. However, to examine an area-based innovation, this paper pays particular attention to both physical and non-physical criteria needed to create an innovation system.

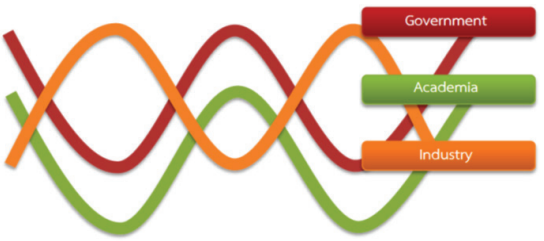

Figure 2:
Triple Helix Concept
Note: Adapted from Curley (2013) Introducing Innovation 2.0

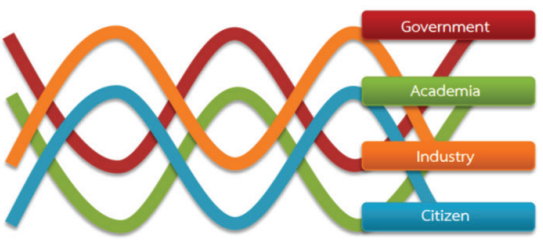

Figure 3:
Quadruple Helix Concept
Note: Adapted from Curley (2013) Introducing Innovation 2.0

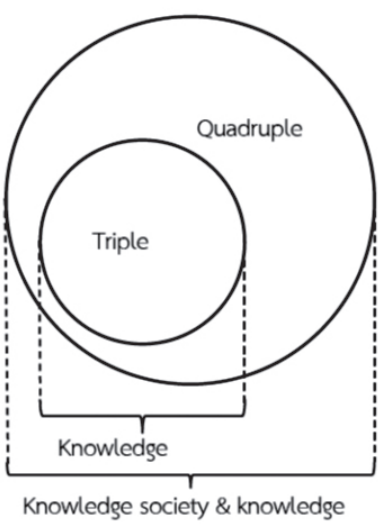

Figure 4:
The Relationship between the Triple and Quadruple Helix
Note: Adapted from Carayannis and Campbell, 2012

B) Innovation Corridor

Camoin Associates (2015), explained that an innovation corridor is designed to accelerate public and private investment, create job opportunities, advance regional competitiveness, and create the magnetism to draw and keep a young, skilled workforce. The development plan for an innovation corridor exploits, connects, and leverages the region's strengths and resources. This also includes key physical and innovation assets, which have been identified in a set of foundational studies and analyses. In addition, the plan includes the means by which to embody specific strategies to fill voids in the region's innovation infrastructure and projects.

Within this paper, two innovation corridors are described; Scandinavian-Adriatic Development Corridor and Iskandar, Malaysia. Whereas the former shows the development of area-based innovation across major cities and countries in northern Europe, the latter shows the smaller picture of spatial development and linkages within a country.

The Scandinavian-Adriatic Development Corridor is the shortest geographical link between the Baltic and the Adriatic Sea. There are 19 Scandria partners from five countries: Sweden, Denmark, Finland, Norway, and Germany. The corridor represents an effective mixture of players from national, regional and local administrations, key logistic participants as well as knowledge and innovation institutions. Scandria is committed to the ideas of a "Green" Corridor of innovation and sustainable growth. Interestingly, some major cities are designated to have special functions; for instance, Oslo and Gothenburg are cities of natural resources and skiing tourism, Stockholm is an educational center of Scandinavia, Oresund region is center of the human capital and Berlin is a center of culture and creativity (Figure 5).

The main objectives of the development are to increase the infrastructural efficiency for passengers and freight, to improve the accessibility of regional economic potentials by activating new value-added chains and innovative, process-optimized logistic solutions, and to build a network of political and economic stakeholders for the corridor's development. Generally speaking, the goals are reflected in the three main thematic pillars: quality of transport infrastructure, innovative logistics solutions, and corridor functionality that integrate economic, scientific and politic aspects altogether.

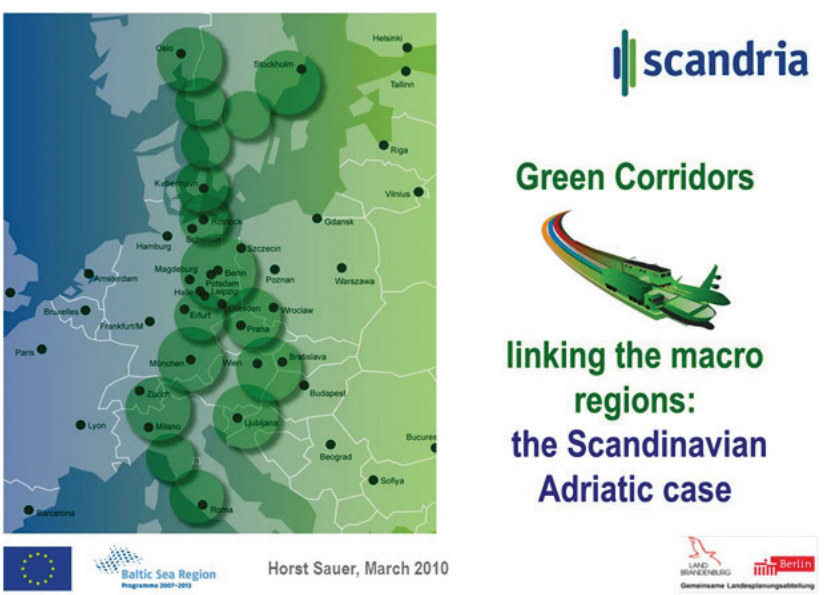

Figure 5:
The Scandinavian-Adriatic Development Corridor
From http://slideplayer.com/slide/7688756/

Iskandar Development Region (IDR) or South Johor Economic Region (SJER), the southern part of Malaysia, has been designated as a special economic region. The area aims to serve and promote the business of creativity, education, and innovation, health, logistics, tourism and recreation, finance, and skilled industries; petrochemistry, bio-fuel, electronics, food, and agro-sciences.

The idea to develop this special zone started in 2006 whereas 2025 is the target date to established these goals. Iskandar is a commercial area that could provide links with Singapore and attract many Singaporean entrepreneurs. This is because of Singapore's physical limitations and the populations' high cost of living. Thus, a new business model for Singapore-based and Iskandar-based has emerged.

In terms of investment privileges approved by the federal government, the following special measures were established:

- Investment incentives in each area to attract investors.
- Measures to reduce income tax for knowledge workers. This is to attract skillful professional workers.
- Investors and foreigners can own a freehold.
- The development of a flagship project aims to encourage cluster and business investment. A physical development plan has been made and divided into 5 zones (Figure 6).
    - Zone A (Johor Bahru City Centre): a business district for a holiday and shopping destination
    - Zone B (Nusajaya): the governing center, medical center, tourism, and logistics hub
    - Zone C (Western Gate Development): a world-class port and a home to the petrochemical and power plants
    - Zone D (Eastern Gate Development): a center for industrial estate and logistics.
    - Zone E (Senai-Skudai Development): a transit town and a home to the Senai Airline

In summary, those two case studies show that an innovation corridor is a regional-scale development policy that indicates concrete possible visions and objectives. Appropriate socio-economic functions for

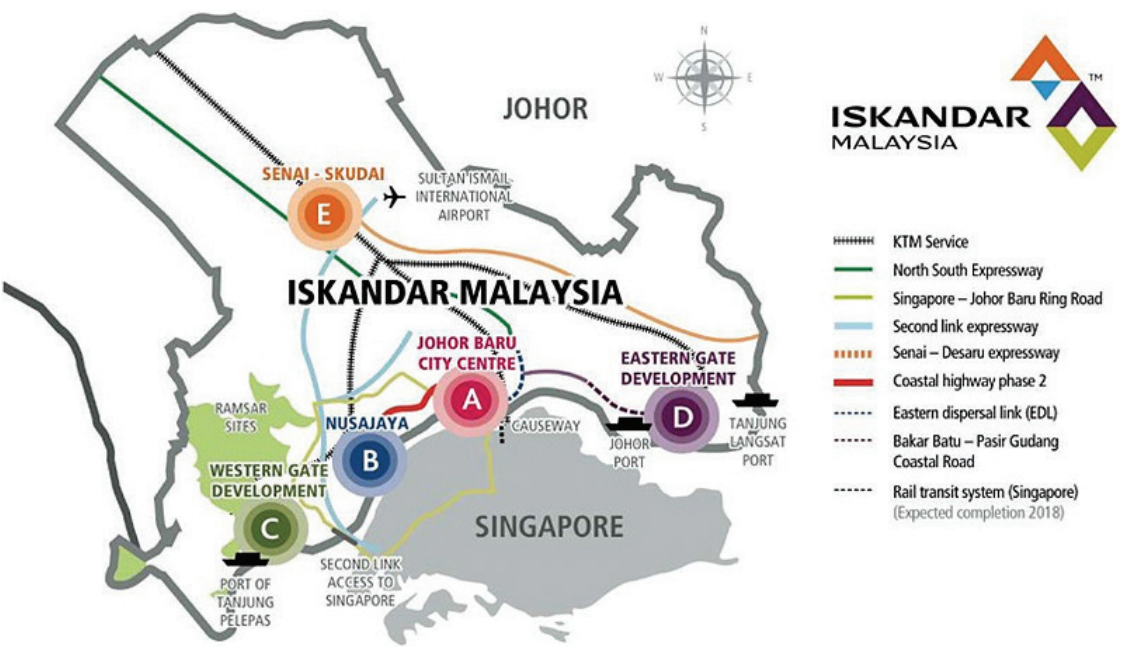

Figure 6:
Iskandar Development Region (IDR)
From http://mole.my/iskandar-malaysia-records-rm237-billion-in-cumulative-investments/

each major city in any corridor should be identified along with spatial connections through transportation and logistics solutions.

There are many criteria concerning assessment and factor comparison in examining an area-based innovation system. The decision-making process is related to a plurality of points of view, some in favor and others against a certain decision (Figueira et al., 2005 in Kasie 2013). The Multiple Criteria Decision Making (MCDM) model was constructed to study multifaceted issues. The MCDM is defined as a decision-making tool to be used in the presence of multiple or conflicting criteria for judging the alternatives. It addresses the need for making compromises or trade-offs regarding the outcomes of alternative courses of action (Masud and Ravindran, 2009; Ehrgott et al., 2010 in Kasie 2013). Moreover, the MCDM is also noted as an integrated analysis comprising of three critical processes: searching for the solution, proposing alternatives and making a decision on selection (Saravisutra, 2559).

MADM (Multiple Attribute Decision Making) is an approach to the MCDM problems. It focuses on selecting the best alternatives from a finite set of alternatives or to prioritize these set alternatives. In the MADM approach, alternatives are discrete and predetermined. The final decision may be sorting, ranking, screening or selection alternatives based on their attributes (Kasie 2013). SMART (Simple Multi-Attribute Rating) and AHP (Analytical Hierarchy Process) are well-known methodological tools for studying such various attributes.

SMART was proposed by Edwards in 1971. It is a simple comprehensive model of decision-makers to account for aspects that are qualitative and quantitative. SMART weighs each of the criteria to reflect its relative importance in selecting the best alternative. The advantage of this method is that attributes are preferentially independent i.e. the decision maker's preference or feelings regarding the value of one attribute are not influenced in any way by the values of the other attributes (Fishburn, 1976 in Kasie 2013). This characteristic is particularly useful when new alternatives or criteria are added to the existing comparison. Any further evaluations necessarily need not begin right from the start but the process can continue from the previous scores obtained (Valiris et al., 2005 in Kasie 2013). SMART can also be applied to any number of alternatives or criteria without limitation. However, the disadvantages of SMART is its priority and score result may not be consistent.

AHP was initially developed by Thomas Saaty in 1980. It is a theory of measurement that uses pairs' comparisons in addition to expert judgments and is a type of additive weighting method (Figueira et al., 2008, and Kahraman, 2005 in Kasie 2013). It is a systematic decision-making tool that can be applied to many professions, for instance; planners, social scientists, and economists. It allows decision makers or policymakers to evaluate complicated problems and issues. Furthermore, the method contributes in identifying numerical values for the objective stimuli related to the given problem through conducting comparisons between the various criteria that affect the problem directly (Satty, 1990; Stam and Silva, 2003 in Tontisirin and Anantsuksomsri, 2012: p: 87-88).

AHP uses "pair-wise comparisons" and matrix algebra to weight criteria. The decision is made by using the derived weights of the evaluative criteria (Saaty, 1980). AHP results are more consistent and accurate than other methods as the size of a matrix is not greater than ten criteria. On the contrary, its consistency deteriorates and it becomes tedious and time-consuming when the numbers of factors are increased. Another limitation of AHP is the rank reversal phenomenon. Simply by adding another alternative or criteria to the list of choices being evaluated, the ranking of two other options, not related in any way to the new one, can be reversed (Golden et al., 1989; Belton and Goodwin, 1996; Valiris et al., 2005 in Kasie 2013).

However, this paper realizes the complicated components of the innovative system comprising various tangible and intangible factors. A pair-wise comparison, which is an AHP principle, seems to meet the nature of the study. A consideration of each pair of factors could bring favorable and clear results rather than an assessment of weights for the criteria at one time. Therefore, this paper selected the AHP as a major methodological approach to defining and prioritizing area-based innovation development.

The model structure of AHP generally consists of three hierarchical levels (Figure 7).

- Level 1 stands for the goal or the development objective.
- Level 2 contains aspects, indicators or factors needed for development achievement.
- Level 3 consists of the alternatives, in terms of the activities, strategies or projects that might be engaged in to meet the aspects of the previous level

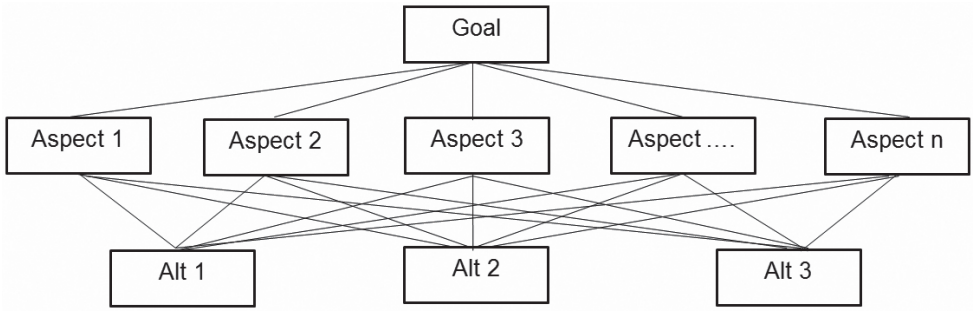

Figure 7:
Hierarchical Levels of AHP
Noted: adapted from Tontisirin and Anantsuksomsri, 2012: p: 87-88

In order to perform the analytical hierarchy process, it is necessary to undertake the following steps (adapted from Saaty, 2008 in Aldegheishem, 2014: p.114).

- Constructing the hierarchical model, including the higher level that represents the desired goal; the middle level that represents criteria or sub-criteria that influence the goal; and the lower level that represents the suggested alternatives and solutions that will be compared and differentiated in order to achieve the goal.

- Providing special questionnaires and conducting personal interviews with experienced people and researchers who are familiar with the issues.

- Designing a pair-wise comparisons matrix, where elements are compared by a two-way method for each as shown in Table 2.

- The elements (C1, C2, C3) in the left column are compared to the elements (C1, C2, C3) in the first row of the matrix. The diagonal line values are always equal to 1 as the comparisons are conducted for the elements by themselves. Then, the rest of the matrix is completed with the inverted value, called the contradictory matrix.

- Calculating the priorities and measuring the consistency by maintaining a single priority for each activity, is known as Eigenvector. It can be calculated by the sum of the column's elements in each matrix then dividing each element in the sum of the column. However, calculating the average of each column on the new matrix represents a new matrix called the priority matrix. AHP measures the total consistency for judgments by calculating the consistency ratio that must be 10% or less to indicate the judgments are somewhat random.

- To calculate the consistency ratio, the following formula is applied (Stam and Silva, 2003 in Aldegheishem, 2014, 115):

Table 2: Criteria Pair-wise-comparison matrix

Goal	C1	C2	C3
C1	1	a_{12}	a_{13}
C2	a_{21}	1	a_{23}
C3	a_{31}	a_{32}	1

C.R. = C.I /RI

C.I. = (λmax – n) / (n-1)

Where; N is a number of the matrix elements; λmax is calculated by taking the result of the division (multiplying the contradict matrix by the priority matrix) on the priority matrix.

- The priorities of the alternatives must be calculated relative to the criteria in order to reach the final solution. Finally, the total priority for each matrix is calculated to reach the final step represented by multiplying the criteria-priority matrix by the alternative-priority matrix.

In summary, AHP has recently been integrated into many urban planning and development projects, for examples; rural development, coastal development for tourism, and logistics planning. The greatest advantage of using AHP is the ability to combine quantitative and qualitative methods, including tangible and intangible criteria, in the decision-making process. It also allows collective decision making, incorporating public participation from the community and insights and opinions form interdisciplinary experts. However, there are some disadvantages in AHP model, in particular when the decision is made in a context of strong uncertainty, as in financial investment decision and political conflict resolution, since the decision structure in AHP does not allow for a feedback mechanism (Tontisirin and Anantsuksomsri, 2012, 90).

RESEARCH METHODS

This research examines the innovation system in Thailand to prioritize the factors or indicators that potentially shape the innovation corridor along the east-west central part of the country. AHP was a major analytical technique. Upon the completion of this study, significant factors could be identified and applied as strategies for area-based development that serve innovators and innovation in Thailand.

Initially, three hierarchical levels for the AHP technique were constructed (Figure 8). The first level is the NIA's concept of an innovative system development was employed as a framework; comprising of physical components, institutions, linkage across sectors, resources and citizen. The second level, detailed

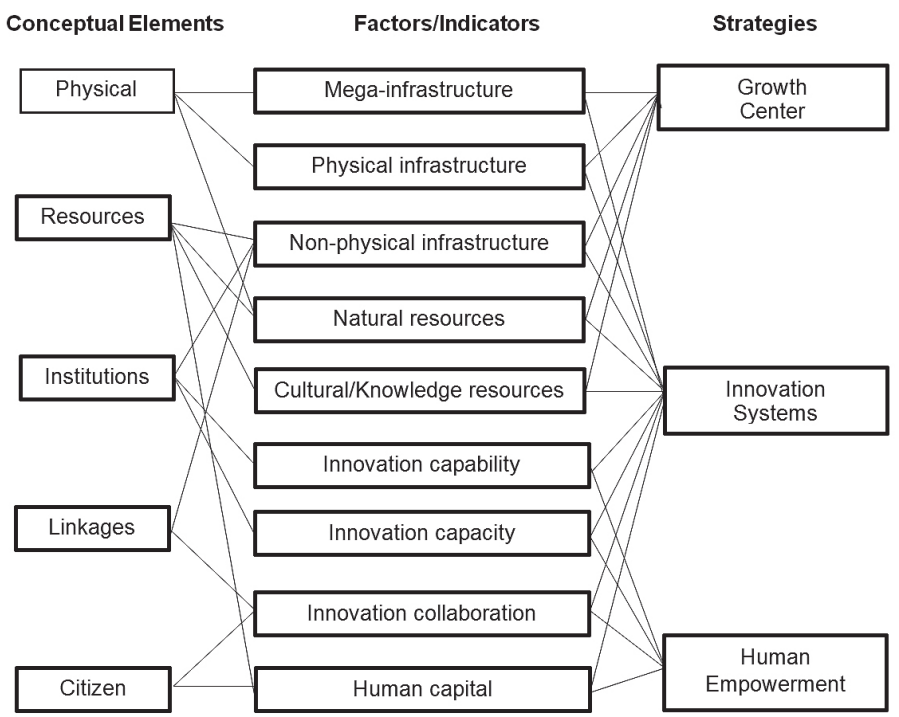

Figure 8:
Three Hierarchical Levels for the AHP Technique

factors associated with those aforesaid concepts were listed. These criteria were set based on reviewing previous literature and early studies related to the innovation system. The third level, the NIA strategic plan concerning with the development of area-based innovation was identified.

Second, the definition of each factor or indicator according to conceptual elements of an area-based innovation system is described.

- Mega infrastructure is categorized under the element of physical. It means an infrastructure normally invested by the government. It connects major cities along the corridor, such as highway network, ports, airports, railways.
- Physical infrastructure is also grouped as one of the physical elements. It can be called a built environment or spaces in a city that can support the creation of innovation. It could also mean the existence of innovation incubator spaces, labs, or research centers in a city.
- Non-physical Innovation Infrastructure means soft-sided infrastructure such as incentives or business programs that drive innovation. The incentives can be financial support, tax deduction, and other regulations that could motivate innovation creation.
- Natural Resources mean natural sources or assets of a place that can be utilized as inputs of production. Land, water, mineral, and tourism destinations are examples. This indicator can be categorized under the element of physical and resources.
- Cultural/Knowledge Resources are defined as soft-sided spatial assets. Knowledge, local wisdom, and culture embedded in the cities are also resources enhancing the production of innovation.
- Innovation capability is grouped by institutional elements. It indicates the maximum level of ability and competence of each public and private organization to produce innovation.
- Innovation capacity means a currently achievable level of ability of such institutions to create innovation.
- Innovation collaboration is categorized into the component of linkages. It means a network of joint efforts between public, private, educational sectors and people. The collaboration may be in the form of academic researches, projects, or business activities.
- Human Capital is associated with the component of the citizen. It means skills, knowledge, attitudes, and experiences of the people. Although they are individual characteristics, it helps generate socio-economic value for the country.

Within this study, it is worth noting that both physical and non-physical presences are considered factors indicating the creation of an innovation corridor. According to the NIA's concept of innovative system development (Figure 1), placing the citizen at the center implies two critical issues. First, people need resources and physical elements to serve their living and working in an innovative environment. Secondly, people are also a part of institutions. They need connection channels or soft-sided infrastructure that could strengthen people interaction and participation.

Third, a questionnaire was developed for the pair-wise comparison (Table 3). Eleven experts in the area of planning and development from public organizations and educational institution were invited to give the ideas toward those aforesaid factors.

- 2 Urban planners and designers from public organizations
- 1 Urban planner and designer from educational institution**s**
- 2 Civil engineers and transportation planners from public organizations
- 1 Civil engineer and transportation planner from an educational institution
- 3 Policy makers from public organizations
- 2 Industrial or business investors from public organizations

They compared the intensity of importance between each pair-wise factor, ranging from the score 1-9 (Table 4). If an expert gives a score of 9 to human capital when compared to mega-infrastructure, this means that the expert values human capital to be extremely more important than mega-infrastructure in triggering innovation. However, if the expert gives a score of 1, it means both variables are equally important.

Statistical software was used for an analytical procedure. A calculation was conducted to examine the weight of each factor that shows the significance. Thus, prioritized by the weighing score could identify a strategic plan for shaping the innovation system along the innovation corridor.

Table 3: An AHP questionnaire for the pair-wise comparison

Factors/Indicators	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Factors/Indicators
mega infrastructure																		physical infrastructure
mega infrastructure																		non-physical infrastructure
mega infrastructure																		natural resources
mega infrastructure																		cultural/knowledge resources
mega infrastructure																		innovation capability
mega infrastructure																		innovation capacity
mega infrastructure																		innovation collaboration
mega infrastructure																		human capital
physical infrastructure																		non-physical infrastructure
physical infrastructure																		natural resources
physical infrastructure																		cultural/knowledge resources
physical infrastructure																		innovation capability
physical infrastructure																		innovation capacity
physical infrastructure																		innovation collaboration
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innovation capacity																		human capital
innovation collaboration																		human capital

Table 4: Fundamental Scale for Pair-wise Comparisons

Verbal Scale	Numericalrating
Equally Important	1
Equally to moderately	2
Moderatery more important, likely or preferred	3
Moderately to strongly	4
Strongly more important, likely or preferred	5
Strongly to very strongly	6
Very strongly more Important, likely or preferred	7
Very strongly or extremely	8
Extremely more important, likely or preferred	9

RESEARCH FINDINGS AND DISCUSSIONS

The researchers seek to identify component prioritization for innovative corridor development and missing links that, if exist, may create a higher level of area-based innovations. The variables' priority from the pairwise comparison is shown in Table 5.

The study found that the top five rankings (weight over 0.010) were human capital, innovation collaboration, innovation capability, cultural/ knowledge resources, and innovation capacity. Those indicators are associated with the conceptual element of citizen, linkages, and institution. On the other hand, the following factors; non-physical and physical infrastructure, natural resources and mega infrastructure, are classified into the elements of resources and physical infrastructure. Therefore, the results imply the experts' perspectives in that the soft side of innovation systems is more important than the hard components. Generally speaking, human development, institutional development and linkages between them seem to be crucial to Thailand's innovation system, rather than physical infrastructure development concerning tangible elements.

Interestingly, the experts proposed strategies or activities that could strengthen an area-based innovation system. The strategies are divided into three groups.

- **Growth center** means selecting potential cities to be centers for development and connecting to each other by efficient transportation networks. Possible actions to establish the centers are:
    - Promoting and developing a connection to innovative systems with a large infrastructure.
    - Promoting sustainable use of natural resources.
    - Promoting an area referenced policy or plan to clarify the role and physical potentials of each city or province.
- **Human Empowerment** means to increase the degree of scientific knowledge and self-determination in people and in communities in

Table 5: Weighting Score of Each Factor

Rank	Factors/Indicators	Weight
1	human capital	0.19
2	innovation collaboration	0.16
3	innovation capability	0.14
4	cultural/knowledge resources	0.13
5	innovation capacity	0.10
6	non-physical infrastructure	0.09
7	physical infrastructure	0.08
8	natural resources	0.07
9	mega infrastructure	0.05
Total		**1.00**

order to enable them to represent their interests in a responsible and self-determined way. Possible actions to support are:

- Creating a curriculum for higher education focusing on innovation, creativity and modern business administration.
- Developing human resources to support innovation capacity for both the public and private sectors.
- Promoting the integration of research institutes in each district, city or province. This is to enhance the collaboration and connection.
- Integrating innovation units and responsibilities, so that inequality and the redundancy in the role to care would be reduced.

- **Innovation system** means to integrate every indicator as a whole. Possible actions to establish an efficient system are:
  - Improving systems that play an important role in promoting innovation, especially banking and finance and regulations.
  - Determining the direction of the development of the production system into the original ODM (original design manufacturing). This is to drive the entrepreneurs to initiate creativity and design with unique concepts.
  - Shaping marketing strategies that could lead to innovation development within the CLMV market.
  - Promoting innovation through local culture and knowledge. This is to increase the local economic value.
  - Identifying policies and directions for an innovation-driven and creative economy to be more consistent.
  - Supporting the development of public health and education system through researches.

In summary, this paper indicates that all conceptual elements of an area-based innovation system: physical, resources, institutions, linkages, and citizen, must be integrated. Development on a regional scale, like an innovation corridor needs, to focus on both tangible indicators, like mega-infrastructure, as well as intangible indicators, like human and institutional empowerment. More importantly, in the future, knowledge about urban and regional planning and urban design would be critically required for the making of the area-based innovation system. Such disciplines help manage urban space to serve socio-economic changes influenced by national and global development. Interestingly, they would provide guidelines for urban living that tend to be sustainably creative and innovative.

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