ANALYTICAL HIERARCHY PROCESS (AHP): AN APPROACH FOR SELECTING THE BEST-SUITED TRADE BORDER CHECKPOINT ALONG MAE HONG SON (THAILAND) – MYANMAR BORDER

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Abstract - Currently there exists five entry points on the Mae Hong Son (Thailand) – Myanmar border, all of which are being employed as temporary trade checkpoints. This paper examines a process and criteria for selecting the one and only point of entry for future trades. Preliminary investigation involved exploring theoretical frameworks, researching various academic papers, and consulting with relevant authorities. Thereafter, a consultation process was conducted on industry experts and relevant stakeholders. The process adopted an Analytic Hierarchy Process (AHP) approach for Multiple Criteria Decision Making (MCDM). Main criteria emerged from the process were: transport infrastructures, volume of trade activities, bordering communities'infrastructures, support of local authorities and border securities. The evaluation process gave "Huay Ton Nun" point of entry as the best option.

Keywords - MCDM, AHP, Border Checkpoint

I. INTRODUCTION

Mae Hong Son is strategically positioned for links with Myanmar, which is a main hub for raw materials in ASEAN, with further connections to two of the world's largest emerging economies in India and China.

The Mae Hong Son-Myanmar border stretches 483 km long, two thirds of which are land borders, while the rest are water borders – 127 km along Salawin river, and 30 km along Mei river. The North and West of Mae Hong Son are connected to Shan, Kayah and Kayin of Myanmar.

Currently there exists five entry points on the Mae Hong Son-Myanmar border: Mae Sam Lab, Sao Hin, Huay Ton Nun, Nam Peing Din and HuayPhueng. Major exports include Monosodium L-Glutamate, cans of beer, instant coffee and wine. Major imports include livestock (cow and buffalo), carbonated canned drinks, dried chilies and postal packaging products.

Year	Trade Values	Export	Import	Balance of Trade
2015	48,992,323	26,509,092	22,483,231	4,025,861
2016	38,306,628	16,920,082	21,386,546	-4,466,464
2017	37,305,013	20,139,466	17,165,547	2,973,919
2018	55,276,521	27,973,476	27,303,045	670,431

Table 1: Summary of border trades, 2015-2018 (US dollars)

Source: Office of Commercial Affairs Mae Hong Son [1]

Mae Hong Son province has a four-year development roadmap for the years 2018 to 2021. Their growth strategy is to promote and develop commerce, investments and border trades; in addition to the following plans: 1) To develop logistics infrastructure, in order to support border trade with Myanmar, ASEAN associations, and Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC). 2) To develop basic infrastructures around temporary points of entry, with an aim to transform them into a permanent trade checkpoint. 3) To enhance international relations for tourism, culture and western civilisations.

With careful consideration of the roadmap, MCDM is being considered in this a paper as an approach for selecting the best-suited trade border checkpoint from the five current temporary entry points.

II. LITERATURE REVIEW

A. Cross Border Trade

Cross border trade is the exchange of goods between neighbouring countries with connecting borders. Under Thailand Ministry of Interior's Immigration Act., the exchange of goods must occur at allocated border checkpoints. The Office of the National Economic and Social Development Council [2] has defined border checkpoint as the passage through which people and vehicles can enter or exit after formalisingthe required immigration and customs.The Thai government aims to promote international relations amongst the local communities such that at the checkpoint for border trade, the people of Myanmar can benefit from public utilities, consumer goods, and necessity medical care and assistance.A permanent checkpoint would be an agreement between both countries' governments for the benefits of trades, movement of people and vehicles,with a

universal protocol for border-crossing. The following are importantcharacteristicsofa border checkpoint:

1. There is a consistent level of trade and movement of people or is an area with future plans to develop commerce and influential economic activities.
2. Has in place, or has potential for good transport infrastructure, especially if there exists good links to major cities, a whole region, or sub-region.
3. Government agencies and officials are fully equipped to facilitate and govern. Facilities, rules and regulations are in place on both sides of the border for effective governance.
4. There are no securities concerns surrounding the areas, before and after becoming a permanent check point. Any security concerns should be addressed accordingly.

B. Multiple Criteria Decision Making: MCDM

When faced with multiple conflicting criteria, MCDM is used in gauging the competitiveness of each criterion, statedApichatSopadang [3]. It is being utilised in many fields, such as applied statistics and decision theory. His paper used MCDC and AHP in selecting a central depot for distribution of goods. The process included three main criteria in geographical, trade volume and logistic service, with 11 sub-criteria, and 14 sub-sub-criteria.Vivain et al. [4]'s paper is a more straightforward example of AHP in practice. The paper attempts to select a location for an expansion of a new office, from 3 different locations. Criteria used were property price, distance from suppliers, quality of labour pool, and labour costs. Irfan and Beyza[5] showed us how to model AHP as a linear programming problem and solved using WinQSB software. This was a supplier selection problem, looking at the distribution network from a yarn company to its warehouse and customers. AHP was utilised to achieve an optimised supply chain model, where costs is minimised.Selection, and evaluation of criteria is of course a significant process. Nilsen et al.[6] uses AHP for selecting an optimal location for a hotel. The study had 15 sub-criteria, and 3 main criteria: geographical conditions, operation management, and transport facilities, with 63.7%, 25.83%, and 10.47% influence respectively. Eylem and Hassan [7] were looking for an optimal new store location for a Turkish company, Carglass. Main method used was AHP, with both tangible and intangible criteria. A hierarchical model was established following a consultation process with the company's administrative team. This paper shows real insight into how to conduct an analytic hierarchy process in a real-world setting.

III. METHODS

First step in the analytic hierarchy process is to model the problem as a hierarchy. This is the start of a consultation process in which our panel of experts comprehend the problem and attempt to break it down into different steps that the AHP requires. As they work through different levels of the hierarchy, they increase their understanding of the problem, their awareness of every details of the problem and the consensus on each topic.

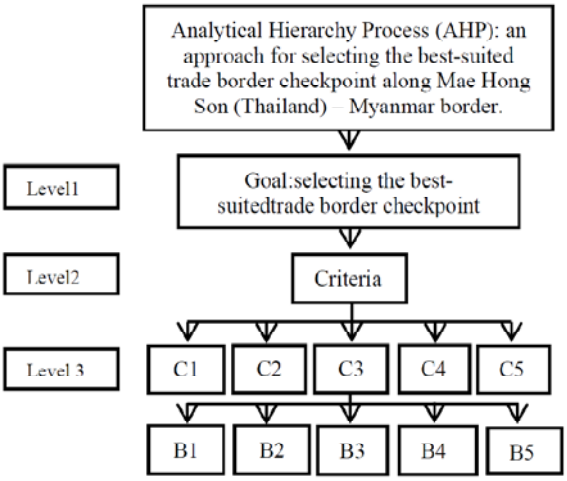


Fig. 1 AHP hierarchy

The following criteria were drawn from academic research and consultation with our panel of experts: transport infrastructures (C1), volume of trade activities (C2), bordering communities' infrastructures (C3), support of local authorities (C4) and border securities (C5). The goal of this AHP process is to then select the best-suited trade border check point from the following alternatives:Mae Sam Lab Point of Entry (B1),Sao Hin Point of Entry (B2), Huay Ton Nun Point of Entry (B3), Nam Peing Din Point of Entry (B4) andHuayPhueng Point of Entry (B5).

Step 1: Pairwise comparisonsof each alternative

Amongst our panel of experts, each pair of alternatives are compared and assigned numerical values based on their relative preference level.Saaty's scale [8], in table 2, is used as a guideline in quantifying the relative preference level.

Preference Level	Numerical Value
Equally Preferred	1
Moderately Preferred	3
Moderately to Strongly Preferred	5
Strongly Preferred	7
Intermediate Values	2,4,6,8

Table 2: Saaty's 1-9 scale

When comparing their transport infrastructures (C1), B1 was judged to bemoderately or strongly preferred to B2, and therefore was assigned a numerical value of 5. Conversely B2 vs B1 was then assigned anumerical valueof 1/5.Looping through each pair of alternatives produces a 5x5 matrix of numerical values. Comparisons are done acrossall five criteria,hence resulting in five 5x5 matrices.

	B1	B2	B3	B4	B5
B1	1	5	1/5	1/3	2
B2	1/5	1	1/7	1/5	1/2
B3	5	7	1	2	5
B4	3	5	1/2	1	3
B5	1/2	2	1/5	1/3	1
CI=0.04545		RI=1.12		CR=0.04058	

Table 3:Matrix of pairwise comparisons based on criteria C1

	B1	B2	B3	B4	B5
B1	1	5	1/5	1/3	2
B2	1/5	1	1/7	1/5	1/2
B3	5	7	1	2	5
B4	3	5	1/2	1	3
B5	1/2	2	1/5	1/3	1
CI=0.04252		RI=1.12		CR=0.03796	

Table 4:Matrix of pairwise comparisons based on criteria C2

	B1	B2	B3	B4	B5
B1	1	5	1/5	2	1/3
B2	1/5	1	1/7	1/2	1/5
B3	5	7	1	5	2
B4	1/2	2	1/5	1	1/3
B5	3	5	1/2	3	1
CI=0.04252		RI=1.12		CR=0.03796	

Table 5:Matrix of pairwise comparisons based on criteria C3

	B1	B2	B3	B4	B5
B1	1	1/5	1/7	1/5	1/2
B2	5	1	1/2	2	3
B3	7	2	1	3	5
B4	5	1/2	1/3	1	2
B5	2	1/3	1/5	1/2	1
CI=0.01641		RI=1.12		CR=0.014656	

Table 6:Matrix of pairwise comparisons based on criteria C4

	B1	B2	B3	B4	B5
B1	1	5	1/5	2	1/3
B2	1/5	1	1/7	1/2	1/5
B3	5	7	1	5	2
B4	1/2	2	1/5	1	1/3
B5	3	5	1/2	3	1
CI=0.04252		RI=1.12		CR=0.03796	

Table 7: Matrix of pairwise comparisons based on criteria C5

Some inconsistencies may typically arise from these pairwise comparisons. For example, if B1 was more preferred than B4, and B4was more preferred than B2, then for consistency, B1 must be much more preferred than B2. In order to make sure the numerical values are consistent across each matrix, a consistency ratio (CR) is calculated, as shown at the bottom of each matrix in table 3 to 7.

The consistency ratio (CR) is measured by the formula:

CR = CI /RI,
where CI = $(\lambda_{max} - n)/(n-1)$. $\lambda_{max}$is the largest eigenvalue of the matrix, and n is the size of the matrix.

RI, the random index, is a constant value based on the size of the matrix (in our case n = 5), which is obtained from table 8.CR calculated above 0.1 signals thatnumerical valueentries are inconsistent, and therefore our panel of experts must re-assess them until the consistency ratio falls below 0.1.

n	1	2	3	4	5	6
RI	0	0	0.52	0.89	1.12	1.25
n	7	8	9	10	11	12
RI	1.35	1.40	1.45	1.49	1.51	1.54

Table 8:Values of random index (RI) for small problems

Each matrix in table 3 to 7 is normalised into a column vector,representing the strength of the alternatives across each criterion. The five column vectors are used to form a 5x5 matrix, M, for the next step of our calculation.

	C1	C2	C3	C4	C5
B1	0.1335	0.1335	0.1335	0.0467	0.1335
B2	0.0449	0.0449	0.0449	0.2592	0.0449
B3	0.4674	0.4674	0.4674	0.4394	0.4674
B4	0.0843	0.2699	0.0843	0.1670	0.0843
B5	0.2699	0.0843	0.2699	0.0877	0.2699

Table 9:Strength of the alternatives across each criterion (Matrix M)

Step 2: Pairwise comparisons of each criterion

After performing pairwise comparisons on the alternatives,the same process is performed on each pair of criteria, judging their relative importance, thereby producing another 5x5 matrix.

	C1	C2	C3	C4	C5
C1	1	5	7	1	1/2
C2	1/5	1	1	1/5	1/3
C3	1/7	1	1	1/5	1/7
C4	1	5	5	1	1/2
C5	2	3	7	2	1
CI=0.04545		RI=1.12		CR=0.04058	

Table 10:Matrix of pairwise comparisons of each criterion's importance

Again, this matrix cannormalised into a vector,v, representing the strength of each criteria.

Final strength of criteria					
	C1	C2	C3	C4	C5
Weight	0.2682	0.0638	0.0503	0.2507	0.3670

Table 11:Final strength of criteria (Vector v)

Step 3:Ranking of alternatives

The cross product of vector v (table 11) and matrix M transposed (table 9)gives us the final strengthof alternatives.

Final strengthof alternatives		Ranking
B1	0.1118	4
B2	0.0986	5
B3	0.4603	1
B4	0.1169	3
B5	0.2124	2

Table 12: Final strengthof alternatives

The resulting vector can be interpreted as final scores for each of the alternatives. B1 to B5 can be ranked based on their scores. Huay Ton Nun (B3) scored significantly higher than the second best, HuayPhueng (B5), and therefore is a clear winner as the best suitedtemporarily point of entry to be turned permanent.

CONCLUSIONS

Mae Hong Son is strategically positioned for links with Myanmar, which is a main hub for raw materials in ASEAN, with further connections to two of the world's largest emerging economies in India and China. Currently there exists five entry points on the Mae Hong Son-Myanmar border: Mae Sam Lab, Sao Hin, Huay Ton Nun, Nam Peing Din and HuayPhueng. Mae Hong Son province has a four-year development roadmap for the years 2018 to 2021. Their growth strategy is to promote and develop commerce, investments and border trades; in addition to the following plans: 1) To develop logistics infrastructure, in order to support border trade with Myanmar, ASEAN associations, and Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC). 2) To develop basic infrastructures around temporary points of entry, with an aim to transform them into a permanent trade checkpoint. 3) To enhance international relations for tourism, culture and western civilisations. With careful consideration of this roadmap, MCDM is being used as an approach for selecting the best-suited permanent trade checkpoint, based on five different criteria:transport infrastructures, volume of trade activities, bordering communities' infrastructures, support of local authorities and border securities. Resulting clear-cut outcome from the analytical hierarchy processbacked "Huay Ton Nun" point of entry as the best option.

REFERENCES

[1] "Summary of border trades 2015-2018 3-5 data sheet"Office of Commercial Affairs Mae Hong Son, Thailand, 2019.

[2] "Key Factors for Consideration 1-4 data sheet," The Office of the National Economic and Social Development Council, Thailand, 2016.

[3] A. Sopadang, Decision Making for management.Chiang Mai: Chiang Mai University, 2009.

[4] V. B. Lobo, N. Ansari, B. B. Alengdan, P. Gharat, E. Jacob, and P. Mishra, "Location Selection for a Company using Analytic Hierarchy Process," International Journal of Advanced Research in Computer and Communication Engineering., vol.5, pp. 189–196, Oct. 2016.

[5] I.Ertugrul, and B. Ozbay, "SUPPLY CHAIN OPTIMIZATION AND DISTRIBUTIONNETWORK APPLICATION WITH AHP INA YARN COMPANY,"TEKSTİL ve KONFEKSİYON 23(2),pp. 87-93, 2013.

[6] N. Kundakci, E. A. Adali, and A. T. Isik, "TOURIST HOTEL LOCATION SELECTION WITH ANALYTIC HIERARCHY PROCESS," Journal Of Life Economics, pp.47-58, 2015.

[7] E. Koc, and H. A. Burhan, "An Application of Analytic Hierarchy Process (AHP) in a Real World Problem of Store Location Selection"Advances in Management & Applied Economics.,vol. 5, pp. 41-50, 2015.

[8] A. C. Caputo, P. M. Pelagagge, P. Salini, "AHP-based methodology forselecting safety devices of industrial machinery," Safety Science 53, pp. 202–218, 2013.

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