

Assessment of Thailand's Border Special Economic Zones by Infrastructure and Border Trade Facilitation Indices

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Abstract:

This manuscript presents the combination of infrastructure and border trade facilitation indices to determine the suitability of locating special economic zones along Thai borders. Existing infrastructure and transportation data were collected from primary observations in eight towns. Infrastructure index component includes transportation, electricity and power, water supply, telecommunication and tourist attractions. Cross-border transportation index components include customs and immigration procedures and facility managements, as well as facilities for labor and freight movement, e.g., gas stations, vehicle maintenance shops, warehouses, hospitals, and cross-border structure. Each is evaluated for their sufficiency, quality, and proximity to raw materials/export hubs. Scores were weighted by different industry types, i.e., textiles, agriculture and food processing, trade zone, logistics center, and tourist center. Findings indicate the importance of infrastructure development and trade facilitation at cross-border checkpoints. These can be a guideline for government to determine the improvement effect of infrastructure in the future.

Keywords: Cross-border Transportation, Infrastructure Analysis, Special Economic Zone, Transportation Planning

1. INTRODUCTION

According to Thailand's Office of Prime Minister Regulation 2013, the Special Economic Zone (SEZ) is defined as the specific areas designated by the SEZ committee to develop infrastructure and convenient cross-border service system to accommodate economic growth. This SEZ concept is very popular in many countries around the world nowadays with the aims to increased trade, increased investment, job creation and effective administration (The World Bank Group, 2008). The SEZs are mostly located in the border areas where business and trades laws are differ from the rest of the country. Besides the regulations, government will promote development in infrastructure and related-border trade facilitation to encourage domestic and international investments within the zone. Normally, this zone can be designed to be export processing zone, trade zone, or tourist zone based on zone characteristics and business demand.

This research collects and analyzes infrastructure and cross-border transportation data at eight

potential border special economic zones according to Thai government proposal. The eight zonal infrastructure data including highway, railway, airport, port, electricity and power, water supply and sanitary, telecommunication, and tourist attractions are evaluated by infrastructure index based on sufficiency, reliability and proximity to zone. Also, the border trade facilitation index considers ease, congestion, and standardization of labor and goods movement across the border. It includes customs and immigration management and facilities, gas station, vehicle repair shop, warehouse, hospital, and cross-border infrastructure. These two indices are combined and differently weighted based on possible business and industrial activities and resulted in ranked scores that can be used to assess government development plans and check the readiness of zonal infrastructure towards investor demand.

2. LITERATURE REVIEW

The readiness of Infrastructure at industrial or business locations is crucial for successful border area development since these areas have been less developed than central parts of Thailand as many border towns still do not have sufficient power and water supply. Rudjanakanoknad and Limsathayurat (2014) proposed methods to rank each infrastructure subcomponent into four-level scores from 4 (Excellent), 3 (Good), 2 (Poor) and 1 (Very Poor) with the broad definitions as shown in Table 1. This study combined the criteria developed by many international organizations such as the United Nations (2001), Federal Railroad Administration (2011), and Wilbur Smith Associates (2010), etc., and created the infrastructure evaluation index based on its quality, size, and proximity to analyzed zones as shown in Tables 2-4. This index was used to evaluate neighboring countries' cities in which Thai investors are interested. The subcomponents are transportation (highway, railway, port, and airport), electricity and power, water supply and sanitary, and telecommunication.

Besides zone infrastructure, successful special economic zones require fast and efficient movements of goods and labor from neighboring countries. Therefore, border trade facilitation would be analyzed to evaluate how difficulty these movements are. Faculty of Economics, Chulalongkorn University (2011) introduced the border trade facilitation index and several subsequent papers have used it to evaluate the facilitation along GMS economic corridors. This index considers customs and immigration (system and area management), gas stations, vehicle shops, cross-border infrastructure, etc. Each component is ranked into 4 level scores as well. The general criteria are shown in Table 1 with detailed description in Table 5.

Table 1. General Definitions of Infrastructure and Cross-border Trade Facilitation Index

Index Score	Category	Broad Definitions
4	Excellent	Has standard infrastructure/procedures with no obstacles occurred
3	Good	Has mostly standard infrastructure/procedures but obstacles might occur due to high seasonal demand
2	Poor	Has partly standard infrastructure/procedures and delay/problems frequently occurs
1	Very Poor	Has no standard infrastructure/procedures and delay/problems usually occurs; critical system bottleneck

Table 2. Criteria for transport infrastructures (Rudjanakanoknad and Limsathayurat, 2014)

Highway	speed > 120 km/hr	speed 90-120 km/hr	speed 50-89 km/hr	speed < 50 km/hr	Port	Berth L.>3km ,Depth> 14m	Berth L.1-3 km, Depth 8-14 m	Berth L.<1k m, Depth <8m	River Port
Motorway	4.0	3.5	3.0	2.5	within 10-km	4.0	3.5	3.0	2.5
Four-lane Highway	3.5	3.0	2.5	2.0	within 150km	3.5	3.0	2.5	2.0
Two-lane Highway	3.0	2.5	2.0	1.5	within 300km	3.0	2.5	2.0	1.0
Non-asphalt Highway	2.5	2.0	1.5	1.0	Out of 300km	1.0			

Railroad	speed > 120 km/hr	speed 90-120 km/hr	speed 50-89 km/hr	speed < 50 km/hr	Airport	2 Run-ways L >3.5km	1 Run-way L> 2.5km	1 Runway L< 2.5 km
Connected	4.0	3.5	3.0	2.5	within 10-km	4.0	3.5	3.0
within 100km	3.5	3.0	2.5	2.0	within 100km	3.5	3.0	2.5
within 200km	3.0	2.5	2.0	1.5	within 200km	3.0	2.5	2.0
Out of 200km	1.0				Out of 200km	1.0		

Table 3. Criteria to evaluate local utilities (Rudjanakanoknad and Limsathayurat, 2014)

Type	Score	General Definition
Electricity and Power	4	Has sufficient quality electricity/power for industry without any seasonal interruption or shortage.
	3	Has sufficient quality electricity/power for industry for most time of years; interruption or shortage rarely happen.
	2	Has moderate quality electricity/power, shortage frequently happens and partially affects production.
	1	Has insufficient electricity/power which affects production significantly.
Telecom-munication	4	Has quality wireless EDGE/3G/4G system and ADSL internet that fully covers the zone.
	3	Has quality wireless EDGE/3G/4G system and ADSL internet that covers most parts of the zone.
	2	Has low quality wireless EDGE/3G/4G system and internet, disruption frequently happens.
	1	Has no wireless EDGE/3G/4G or ADSL internet; difficult to connect others
Water Supply and Sanitary System	4	Has sufficient quality water supply for all seasons. Good sanitary system and no irrigation or flood problems.
	3	Has sufficient quality water supply for most seasons. Irrigation or flood problem could rarely happen.
	2	Has moderate quality water supply for most seasons or some parts of the zone. Irrigation or flood might happen.
	1	Has insufficient quality water supply or sanitary system; affect production significantly.

Table 4. Criteria to evaluate tourist attractions (for tourist center only)

Proximity to the Zone	Main Tourist Attraction within 2-hr Drive		
	Worldwide Reputable	Nationwide Reputable	Provincial Reputable
Inside the Zone	4	3.5	3
Within 60-min drive from the Zone	3.5	3	2.5
Within 61-120 min drive from the Zone	3	2.5	2

Note: Score = 1, if no reputable tourist attraction within 120-min drive from the Zone

Table 5. Criteria to evaluate border trade facilitation index (Faculty of Economics, Chulalongkorn University, 2011)

CIQ System	4	Fast, reliable system and no hidden fee with online computer technology according to worldwide standard.
	3	Mostly fast and reliable with standard computer system; some personal judgment/practice might occur.
	2	Mainly manual check without computer system; some personal judgment/practice usually occur.
	1	No clear standards; depend on personal judgment/relationship
CIQ Building	4	Has separated standard buildings for customs and immigration with good area management for tourists, truckers, etc. Has sufficient equipment and/or parking area for checking passengers or goods.
	3	Has separated standard buildings for customs and immigration but has limited area management for tourists, truckers, etc. In sufficient equipment and/or parking area for checking passengers or goods during peak
	2	No separated buildings and/or a small building with insufficient parking or customs check for goods. Persons and goods can pass with significant delays.
	1	No separated/too small building that could pose danger to persons or goods
Gas Station	4	Has sufficient standard gas stations with variety of fuel to serve.
	3	Has some standard gas stations with one type of fuel to serve general demand.
	2	Has only substandard gas stations to serve the demand
	1	Has no gas station in the area.
Vehicle Maintenance Shop	4	Has sufficient standard maintenance shops to serve the variety of demand.
	3	Has some standard vehicle maintenance shops to serve only general demand.
	2	Has only substandard vehicle maintenance shops to serve limited demand
	1	Has no vehicle maintenance shop in the zone.
Warehouse Facility	4	Has sufficient standard warehouse facility to serve the variety of demand
	3	Has some standard warehouses to serve only general storage demand
	2	Has only substandard warehouse/area to serve limited storage demand
	1	Has no warehouse/storage in the zone.
Hospital	4	Has sufficient numbers of standard hospitals to serve the variety of demand.
	3	Has some standard hospitals to serve only general demand.
	2	Has only substandard hospitals to serve limited demand
	1	Has no hospital in the zone; patients have to transfer outside.
Cross-border Infrastructure	4	Has standard cross-border facilities (e.g., bridge or standard highways)
	3	Has standard cross-border facilities but might be congested during peak time.
	2	Has substandard facilities with moderately safe access. (e.g., unpaved road)
	1	No safe or reliable cross-border facility; could pose danger to goods or persons.

3. METHODOLOGY

The researchers gathered infrastructure and border trade facilitation component data by field observations and interviews of local governments and businessmen at all eight potential special economic zones proposed by Thai government as shown in Figure 1. Based on discussion with local organizations, the main industrial or business activities at Thai border towns in the near future for special economic zones are belong to any of five categories, i.e., textile industry, agriculture and food processing industry, trade zone, logistics center and tourist center.

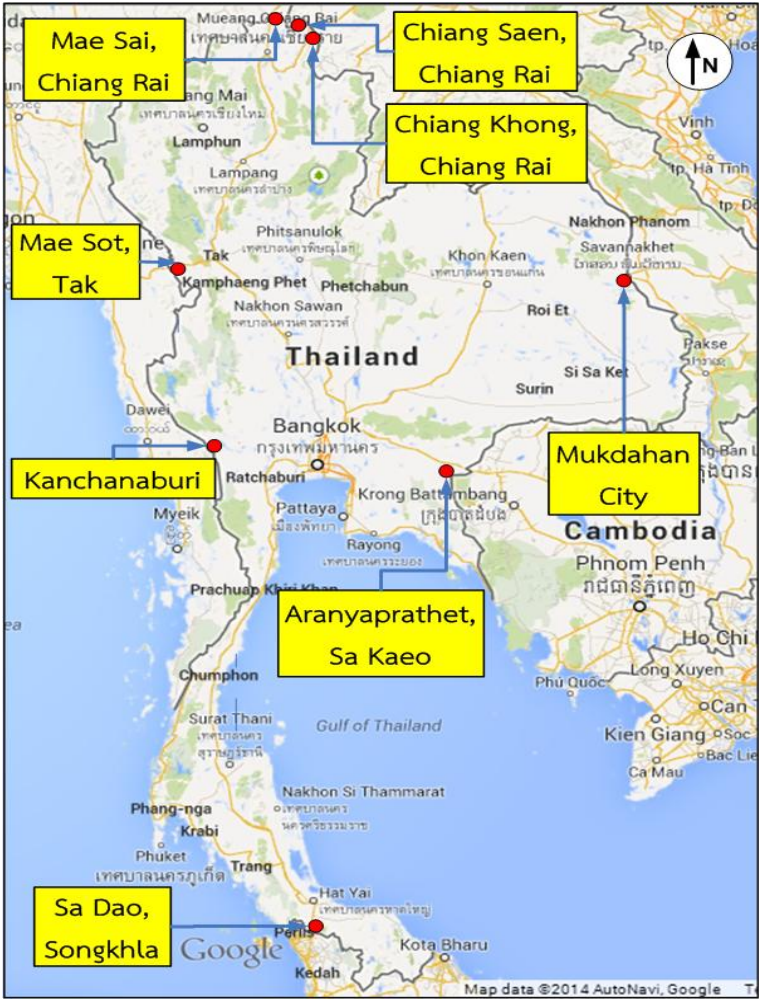


Figure 1. Eight towns proposed by Thai Government (Modified from Google Map)

The data collected in this study for index evaluation includes eight infrastructure subcomponents: highway, port, railroad, airport, electricity/power supply, water supply, telecommunication, and tourist attractions; and nine cross border trade facilitation subcomponents: customs and immigration system and building, gas station, vehicle repair shops, warehouse/storage, hospital, and cross-border infrastructure. Since each industrial activity requires different infrastructures, weights of each subcomponent score in percentage for each index based on interviews of industry experts are determined and shown in Table 6.

Table 6. Weights (%) of Components in Infrastructure and Cross-border Trade Facilitation Indices

Component	Infrastructure								Cross-border Trade Facilitation								
	Highway	Port	Railroad	Airport	Electricity	Telecommunication	Water Supply	Tourist Attractions	Customs Sys.	Customs Bldg.	Immigration Sys.	Immigration Bldg.	Gas station	Vehicle Shop	Warehouse	Hospital	Cross-border Infra.
Textile	30	20	5	5	25	5	10	0	10	10	35	10	5	5	10	5	10
Agriculture	30	20	5	0	25	5	15	0	20	10	20	10	5	5	15	5	10
Trade Zone	30	10	10	5	15	15	15	0	20	10	25	10	5	5	5	10	10
Logistics Center	30	20	10	5	15	10	10	0	15	10	15	5	10	10	20	5	10
Tourist Center	20	5	5	10	10	10	10	30	10	5	30	15	10	5	0	15	10

4. DESCRIPTION OF STUDY ZONES AND HIGHLIGHTS

General descriptions of eight zones and their highlights are shown in Figure 2 and summarized as follows:

1. *Mae Sot, Tak* Overall infrastructure is in moderate level. Although electricity and telecommunication system are fine, they are not ready for large industry expansion. The main problem here is transportation due to under-expansion highway (Tak-Mae Sot), no railway station, and a small airport. The cross-border infrastructure (customs and immigration buildings) is congested and timeworn. This should be rebuilt or expanded to serve more traffic.
2. *Kanchanaburi* Overall infrastructure is in moderate level. It could be good if the expressway and railway connecting Dawei Port to Laemchabang Port are completed. An airport near the border or expansion of Dawei port might be required to serve large industry. In addition, Pu Nam Ron border infrastructure is quite old and must be rebuilt according to the government plan along with customs and immigration system. In addition, large area would be set for warehouse facilities.
3. *Mae Sai, Chiang Rai* Overall infrastructure is in good level. It could be further improved by building the railway connecting to three Chiang Rai permanent border checkpoints (Mae Sai, Chiang San, and Chiang Khong) as well as build a by-pass highway to avoid traffic congestion in Chiang Rai city. For border trade facilitation, overall picture is good to very good. The new customs and immigration buildings, warehouses, gas stations, and hospitals are quite plentiful. However, the second Mae Sai checkpoint cannot be fully utilized due to Myanmar internal minority conflict so that the first one is still congested.
4. *Chiang San, Chiang Rai* Overall infrastructure is in good level. Although Chiang San is an ancient town that might be difficult to build large industry in the area, it has several Mekong ports that connects to Southern China that make it a good place for logistics town. It requires improvement in port and vehicle service centers, more cold store warehouses besides construction of railway and a by-pass highway like Mae Sai.

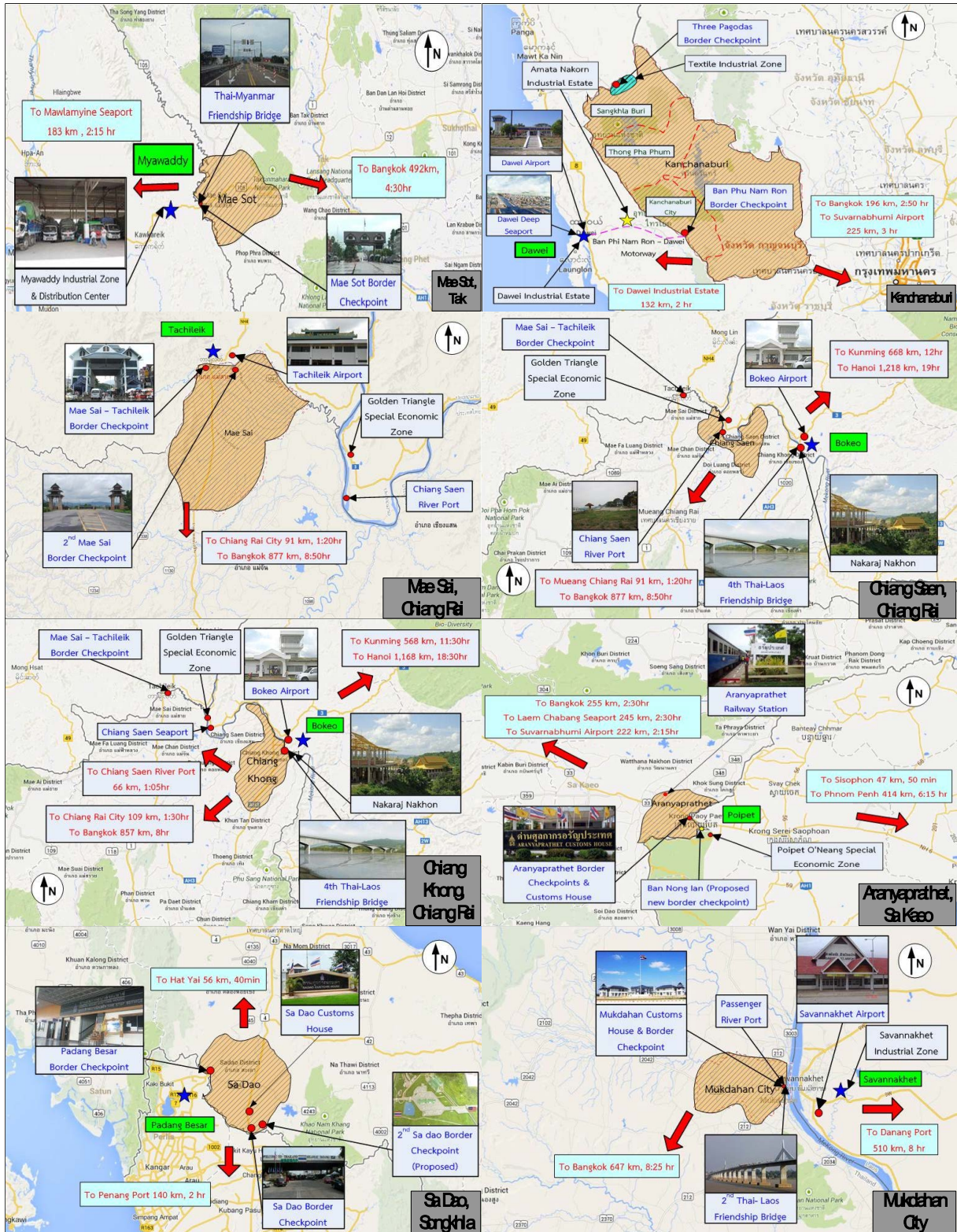


Figure 2. Town connection and important infrastructure (Modified from Google Map)

5. *Chiang Khong, Chiang Rai* Overall infrastructure is in good level. It could be a logistics hub for north-south economic corridor (R3A) so that constructions of railway and a Chiang Rai by-pass highway are required. Cross-border infrastructure is very good since the new

bridge was recently opened. However, Thai government would look into maintenance assistance to Lao PDR for improvement of R3A pavement condition. Also, a hospital is required in this area.

6. *Aranyaprathet, Sa Kaew* Overall infrastructure is in good level except the highways that are under expansion to four lanes (to Sisopon Industrial Estate and Laem Chabang Port) Also, it needs an airport, water supply and flood protection system improvement. For cross-border facilitation, the second checkpoint is crucial to reduce existing truck traffic congestion and delay. In addition, vehicle maintenance shops, warehouses, hospitals, and border connecting road would be improved.
7. *Sa Dao, Song Khla* Overall infrastructure is in good level, i.e., port, airport, electricity can serve large industry well. The major concern is traffic congestion on Highway No. 4 and border checkpoint. This problem could be alleviated if the second Sa Dao checkpoint is open. For railway, water supply, port, they required capacity expansion. In addition, more hospital is necessary to serve labor and tourists.
8. *Mukdahan City* Overall infrastructure is in moderate level. Building a commercial airport and expansion of railway line would make the city more convenient for industry export. This includes assistance to Lao PDR in R9 maintenance to Vietnam border. For border crossing, most facilities are quite good but more warehouses and hospitals are needed for industry expansion.

5. ANALYSIS

5.1 Index Evaluation

The field data are evaluated and component scores are given by the criteria set by Rudjanakanoknad & Limsathayurat (2014) and Faculty of Economics, Chulalongkorn University (2011) in Tables 7. Note that the scores in parenthesis represent the 2025 future condition given that Thai government has concrete plans to improve it in the next ten years. This table is proved to be useful for government agencies as a checklist to determine which items are laggards in each zone.

Table 7. Scores of Components in Infrastructure and Cross-border Trade Facilitation Indices

Border Town	Infrastructure								Cross-border Trade Facilitation								
	Highway	Port	Railroad	Airport	Electricity	Telecommunication	Water Supply	Tourist Attractions	Customs Sys.	Customs Bldg.	Immigration Sys.	Immigration Bldg.	Gas station	Vehicle Shop	Warehouse	Hospital	Cross-border Infra.
Mae Sot	2(4)	2	1(3)	2.5(4)	3	3	2	3	3	2	3	2	3	2	2.5(3.5)	3	2
Kanchanaburi	2.5(4)	4	1.5(3)	2	3	3	3	3	2	1(4)	3	1(4)	4	3	1	3	2
Mae Sai	3	2	1(3)	3	3	3	2	3	3	4	3	4	4	3	4	4	3
Chiang Saen	3	3	1(3)	3	3	3	2	4	3	4	3	4	3	2	4	3	2
Chiang Khong	3	3	1(3)	2.5	3	3	2	3	3	4	3	4	3	3	4	2	3
Aranyaprathet	2(3.5)	3	3	2	3	4	2	2	3	2(4)	3	2(4)	3	2	2	2	2
Songkhla	2(4)	3(4)	2.5(4)	3	3	3	2	3	4	2(4)	3	2(4)	3	3	3	2	3
Mukdahan City	3	1	1	2.5(4)	3	3	2(3)	3	3	4	3	4	4	4	2	2	3

5.2 Analysis by Potential Industrial and Business Activities

The readiness of each special economic zones for different types of industrial and business activity can be analyzed by using weights in Table 6 and the data in Table 7. Table 8 shows the weighted average scores for each index. These scores are examined for both existing and 10-year future scenarios. The discussion of each activity based on investors' interest are follows:

Table 8. Analysis of border town industrial and business activities

Type of Business Activity	Mae Sot, Tak			Kanchanaburi			Mae Sai			Chiang Saen		
	Infra.	Border TF	Average	Infra.	Border TF	Average	Infra.	Border TF	Average	Infra.	Border TF	Average
Existing & Under-Construction												
Textile Industry	2.28	2.60	2.44	2.82	2.25	2.54	2.45	3.40	2.92	2.80	3.15	2.98
Agriculture and Food Processing	2.25	2.58	2.41	2.88	2.05	2.46	2.40	3.45	2.92	2.80	3.20	3.00
Trade Zone	2.22	2.62	2.42	2.70	2.25	2.48	2.40	3.40	2.90	2.75	3.10	2.92
Logistics Center	2.18	2.55	2.36	2.75	2.15	2.45	2.35	3.50	2.92	2.70	3.15	2.92
Tourist Center	2.35	2.65	2.50	2.75	2.50	2.62	2.65	3.45	3.05	3.02	3.05	3.04
Future (with concrete plan to be improved by 2024)												
Textile Industry	3.05	2.70	2.88	3.35	2.85	3.10	2.55	3.40	2.98	2.90	3.15	3.02
Agriculture and Food Processing	2.95	2.72	2.84	3.40	2.65	3.02	2.50	3.45	2.98	2.90	3.20	3.05
Trade Zone	3.10	2.68	2.89	3.30	2.85	3.08	2.60	3.40	3.00	2.95	3.10	3.02
Logistics Center	3.05	2.75	2.90	3.35	2.60	2.98	2.55	3.50	3.02	2.90	3.15	3.02
Tourist Center	3.00	2.65	2.82	3.12	3.10	3.11	2.75	3.45	3.10	3.12	3.05	3.09
Type of Business Activity	Chiang Khong			Aranyaprathet			Sa Dao, Songkhla			Mukdahan City		
	Infra.	Border TF	Average	Infra.	Border TF	Average	Infra.	Border TF	Average	Infra.	Border TF	Average
Existing & Under-Construction												
Textile Industry	2.78	3.25	3.01	2.58	2.50	2.54	2.55	2.80	2.68	2.25	3.15	2.70
Agriculture and Food Processing	2.80	3.30	3.05	2.58	2.45	2.51	2.50	2.85	2.68	2.22	3.10	2.66
Trade Zone	2.72	3.15	2.94	2.60	2.50	2.55	2.42	2.80	2.61	2.35	3.15	2.75
Logistics Center	2.68	3.30	2.99	2.60	2.40	2.50	2.50	2.88	2.69	2.20	3.10	2.65
Tourist Center	2.82	3.05	2.94	2.38	2.50	2.44	2.48	2.70	2.59	2.45	3.20	2.82
Future (with concrete plan to be improved by 2024)												
Textile Industry	2.88	3.25	3.06	3.02	2.90	2.96	3.42	3.20	3.31	2.42	3.15	2.79
Agriculture and Food Processing	2.90	3.30	3.10	3.02	2.85	2.94	3.38	3.25	3.31	2.38	3.10	2.74
Trade Zone	2.92	3.15	3.04	3.05	2.90	2.98	3.28	3.20	3.24	2.58	3.15	2.86
Logistics Center	2.88	3.30	3.09	3.05	2.70	2.88	3.45	3.18	3.31	2.38	3.10	2.74
Tourist Center	2.92	3.05	2.99	2.68	2.90	2.79	3.00	3.10	3.05	2.70	3.20	2.95

1. *Textile Industry* This industry requires efficient immigration system, reliable electricity and power, and good highway or railways to ship products to ports. Although Mae Sot, Kanchanaburi, and Aranyaprathet are targeted zones for Thai investors, these areas require highway and immigration improvement.
2. *Agriculture and Food Processing Industry* This industry requires efficient customs system, reliable water supply and sanitary system, reliable highways or railways to ship products to seaports. Although Chiang Khong and Mukdahan city are targeted zones for Thai investors, they require highway improvement and a railway for efficient port connection. For Kanchanaburi, it requires better cross-border system and infrastructure.
3. *Trade Zone* This zone requires efficient immigration and customs as well as good telecommunication and basic sanitary. Sa Dao, Mae Sai, Mukdahan city are targeted zones for Thai investors. These zones require better highway and railway improvement for freight transportation.
4. *Logistics Center* The logistics center requires good transportation system and warehouse facility as well as reliable cross-border system. Targeted zones for Thai investors are Chiang Khong and Mukdahan city, which are on important economic corridors. For other zones, e.g., Mae Sot, Sa Dao, and Kanchanaburi, they require better highway improvement (or new motorway) and standardized cross-border facilities.
5. *Tourist Center* To become a tourist center, it requires reputable tourist attractions with efficient immigration and transportation system. All Chiang Rai cities and Mukdahan city are potential tourist zones. For Kanchanaburi, it requires highway improvement and an airport. For others, e.g., Mae Sot, Sa Dao, Aranyaprathet, they have no distinct tourist attractions.

6. RECOMMENDATIONS AND CONCLUDING REMARKS

Based on the findings, if these targeted cities are planned to be export processing zones or trade zones., we find that Mae Sot and Kanchanaburi requires much more infrastructure upgrade and constructions than others. The major concern is on transportation infrastructure that can connect the areas to Laem Chabang port. For Chiang Rai and Sa Dao, we found that most infrastructures are quite ready for industry expansion. As for the government planning, it should first set which industry type each area should serve. Then, the prioritization of infrastructure development would depend on the industry. For example, textile and clothing industries requires convenient labor border crossing and efficient transportation system to the port. On the other hand, agriculture processing industries demands more on clean and sufficient water supply and efficient customs system to move agriculture products from neighboring countries.

Besides the zone-specific findings, this research creates the infrastructure evaluation index and border trade facilitation index to measure and compare the readiness and fitness of each special economic zone for different activity types by presenting them in easy-to-present index value. These indices can be used along with other decision making factors, e.g., labor supply, raw material sources, local acceptance, local/neighboring government policy and regulation so that the government could use the analysis to plan needed infrastructure or cross-border

trade facilitation improvement for developing each potential special economic zone according to investors' demand.

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