ECONOMIC IMPACT ANALYSIS: A CASE STUDY OF BANG PA-IN –

NAKHON RATCHASIMA INTERCITY MOTORWAY PROJECT

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This research aimed to achieve the following: (1) to study and perform comparative analysis on the development of transport infrastructure. In the case of Germany, Sweden, Belgium, Austria, Japan and Thailand, the documentary research method was employed; and (2) to analyze the economic impact of the Bang Pa-In-Nakhon Ratchasima Intercity Motorway Project. An analysis of the production factors and outputs that have been further improved in the construction sector of the Bang Pa-In-Nakhon Ratchasima Intercity Motorway Project. These factors will be incorporated into the production and output tables. The aspect of economic expansion was analyzed using the night-time light index and interested person impact analysis by interviewing 10 people. The research findings indicated the following: (1) In Germany, Sweden, Belgium, Austria and Japan there were developments in terms of road transport to connect modes of transport, to develop intelligent digital transportation, and to solve environmental sustainability problems. Thailand has only begun to develop transportation combined with other forms of transportation to support the needs of the people; (2) The backward multipliers of the intercity expressway project mentioned had higher values than the forward multipliers. This demonstrated that the Bang Pa-In-Nakhon Ratchasima Intercity Motorway Project has a greater impact on connecting with other industries in the upstream sector. The Bang Pa-In-Nakhon Ratchasima Intercity Motorway Project resulted in an overall increase of 0.319% in the national gross domestic product (GDP) compared to the baseline case, which is equivalent to a value of 44,368.03 million Baht and job creation. The expansion of night-time lights from before the project showed that the project contributed to economic expansion. The project has a positive impact on increasing the value of land, reducing traffic congestion, travel time, and freight costs, increasing investment trade to spread prosperity to the region, while the negative effects made it more difficult for people to travel in the area and residential land expropriation problems.

Keyword : Motorway Project, Forward-Backward Multipliers, Input-Output Analysis, Economic Impact

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Chapter 1
Introduction

The expansion of transportation infrastructure is an essential element of economic expansion. by infrastructure for transport and economic expansion It is a remarkable expansion in the right direction. Employment results in the expansion of the manufacturing sector, which contributes to increased economic growth. Transportation will contribute the most to sustainability. The factor contributes to the expansion of the nation's production capacity. Increasing the value of available resources is conducive to sustainable development(Raghuram & Babu, 1999). Transportation can expedite and facilitate entry into the production process. It serves as a gateway to other transportation access locations. available more Specifically, efficient road transport will expedite the delivery of products to the market. Contribute to the decrease in production-related transportation costs. This infrastructure can serve as a magnet for regional economic growth (Gramlich, 1994; Ramanathan & Parikh, 1999). Infrastructure development in numerous areas, such as the analysis of the infrastructure deficit's effect on the African economy. This increases the cost of doing business in Africa by at least 2% per year. If investments in sustainable transport infrastructure are made, if there was appropriate infrastructure, an additional 1 percent would increase GDP per capita growth by 0.6%. The private sector in Africa can increase its productivity by as much as 40 percent (Bank, 2013). can provide cheaper, safer, and more timely products and services to the market, thereby encouraging foreign direct investment (Schwab, 2015). Effectively competing will be possible for East Africa. bolster investment and commerce Through infrastructure development , the lengthening of roads contributes positively to economic expansion resulting from the city's growth.

According to Datta (2008), India's road quality increases productivity. enhancing the quality and width of existing highways to connect the four greatest metropolitan areas. aids in reducing production costs Investments in road transport infrastructure have a significant impact on economic development, both in the short and long term. Long-term investments in transportation infrastructure an increase of 1

percent increased economic growth by 0.062%. In contrast, a 0.089 percent increase in government expenditure resulted in a 7.5% increase in gross domestic product (GDP) over a two-year period, whereas the cost-budget loss will have a negative impact in the short term due to its magnitude. Large investments in urban transport infrastructure networks, via highways, expressways, and related roads, especially in urban and municipal areas, contribute to economic growth (Muvawala, Sebukeera, & Ssebulime, 2021), and it is known that developing efficient transport systems or improving existing systems contributes to economic growth. It requires millions or billions of dollars in investment. especially with regard to public funds. This is an essential issue to address. Specifically in terms of the decline in public income relative to the necessary development expenditures. Particularly because of government project investment decisions. Which investment yields far-reaching results? Including the capacity to generate revenue from the investment value of each project that must be written off (Koppenjan, 2008). when contemplating on a project-by-project basis whether something is effective or not. or public funds will be allocated to other initiatives. Will it have a positive effect on areas such as health, energy, and infrastructure? All of these are acknowledged as essential public values (Bruijn & Dicke, 2006).Due to the high investment cost and lengthy lead time, transportation-related initiatives frequently encounter issues. Investment in infrastructure development initiatives for maximum returns is evident. The most appropriate method must be used by government agencies to evaluate the economic benefits generated by transportation initiatives. It is essential to determine whether or not these initiatives are worth the investment and expenses. Alternatively, the funds would be better spent elsewhere.

Development of Thailand's transportation infrastructure It is a crucial stage in its evolution. Both road transport, railways, ports, waterways, and airports are significant economic development drivers. If the infrastructure is efficiently developed, it will be one of the most important factors in fostering competitiveness. Increase the likelihood of economic expansion It is also preparation for a robust economy that is conducive to growth in all areas. countryside in tandem with Thailand's expansion The rapid

development of the city is supported by the industrial sector, the agricultural sector, and the service sector (tourism). Transportation is crucial to the distribution of goods to domestic and international markets. by transporting products throughout the supply chain. The quantity of products will increase in accordance with the economic conditions of the nation. Figure 1 illustrates the trend in transportation costs and the gross domestic product.

Logistics Costs
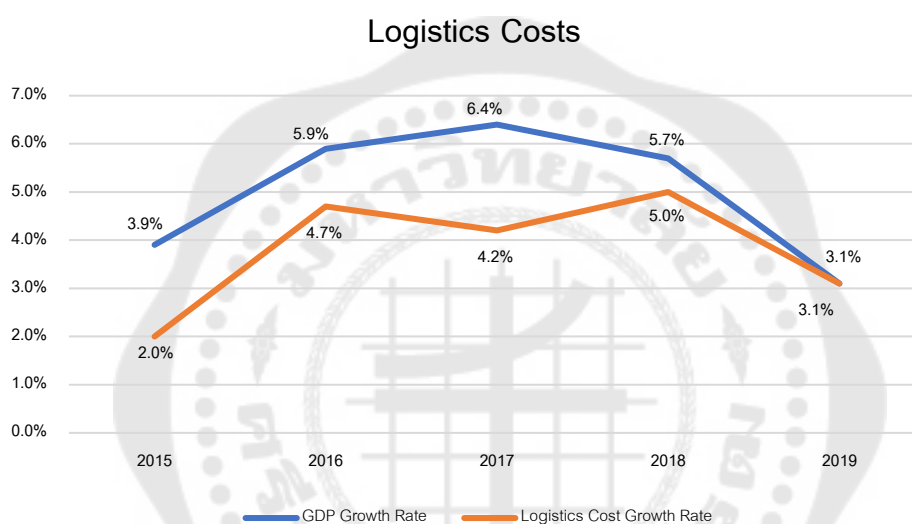
Figure 1 represents the upward trend of transportation costs and gross domestic product.

Source: Office of the National Economic and Social Development Council (2020)

Transportation costs and gross domestic product are increasing in the same direction. It highlights the relationship between transportation infrastructure development and economic expansion. If further transportation infrastructure development increases comfort, shortens travel time, and reduces logistics costs, The economy will increase. However, development should take into account the proportion of domestic transport modes. There are five primary modes of transportation for products in Thailand,

including 1) road transport. It is transported by a variety of trucks, including pick-up trucks, container trailers, and refrigerated vehicles, among others. 2) Rail transportation or rail network It is a freight train with multiple routes and various modes of transportation. Including both bulky, containerized, and liquid products. The State Railways of Thailand (SRT) is the only service provider. 3) Pipeline conveyance It refers to the transportation of liquids such as water, oil, natural gas, and compounds, among others. 4) Transport by water the majority of them are used to transport large cargo. As for coastal transportation, auxiliary ships are used to support export and import activities between sub-ports and main ports or deep-sea ports; 5) air transport It is frequently valuable cargo. Low-weight products or commodities that must be transported quickly to prevent damage, or perishables requiring special handling. On average, Thailand transports approximately 805 million tons of products and services per year. In Thailand, road transport accounted for 86.51 percent of the total volume of transport. While the cost of transportation is 1.38 baht per ton per kilometer. It indicates that the primary mode of conveyance in Thailand is road transport(Planning, 2019) As depicted in Figure 2, the government prioritizes the development of road network infrastructure over other forms of transport infrastructure development.
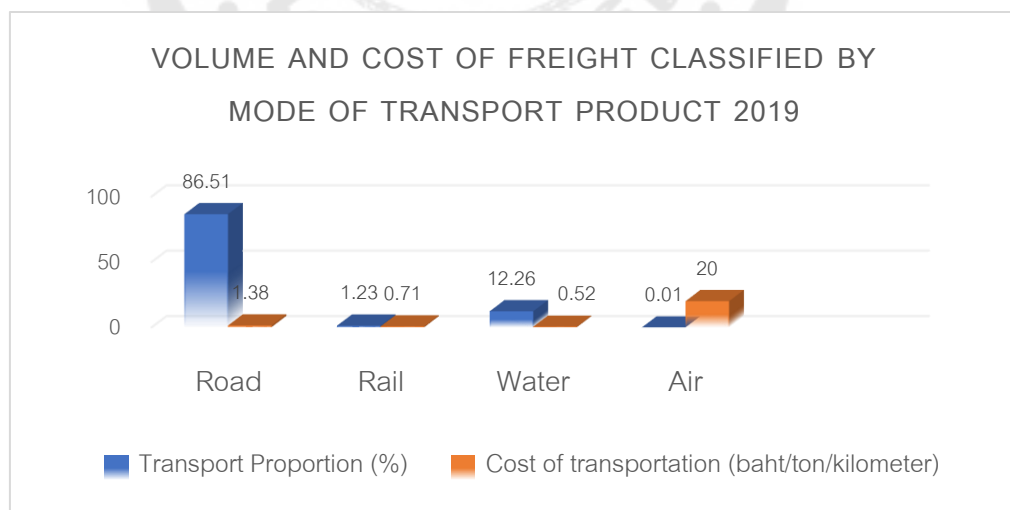
Figure 2 Volume and Cost of Freight Classified by Mode of Transport Product 2019

Source: Office of Transport and Traffic Policy and Planning (2019)

Thailand's investment policy to develop critical infrastructure in accordance with the 12th National Economic and Social Development Plan for the period 2017–2026, infrastructure investment is required. The total investment is approximately 3,099 trillion baht, with a focus on investments in transportation (approximately 56.13 percent), energy (electricity) (approximately 41.96 percent), and the foundation for the development of the country's infrastructure (approximately 40 plans). During the plan's duration, expenditures total approximately 2.27 trillion baht (an average of approximately 454 billion baht per year), with investments in transportation accounting for up to 1.49 trillion baht (or 65.69 percent) and energy for 0.63 trillion baht (or 28.15 percent) of the total. It demonstrates that the government prioritizes the development of transportation infrastructure. In accordance with Table 1 (Office of the National Economic and Social Development Council, 2020).

Table 1 Estimated investment framework for major infrastructure development under the development plan National Economic and Social Issue No. 12 (unit: million baht)

Sector	Total Investment Limit	2017	2018	2019	2020	2021	Total	Percent
1. Transportation	1,673,352	308,295	405,832	396,831	260,678	119,550	1.491,186	65.69
2. Development of facilities	25,232	3,785	5,276	6,233	5,857	2,025	23,175	1.02
3. Logistic	3,950	790	790	790	790	790	3,950	0.17
4. Energy	1,239,105	94,514	155,765	146,791	119,920	122,185	639,174	28.15
5. Digital Economy	44,186	5,754	7,295	6,921	4,795	3.177	27,942	1.23
6. Public assistance	113,340	14,267	16,695	19,134	20,013	14,666	84,776	3.73
Total	3,099,164	427,404	591,653	576,700	412,053	262,393	2,270,203	100
Percent		18.83	26.06	25.40	18.15	11.56	100	

Source: Office of the National Economic and Social Development Council (2021)

Transportation infrastructure construction It is administered in accordance with Issue 7 of the National Strategic Master Plan, Logistics and Digital Infrastructure

Development. To serve as the foundation for developing the nation's competitiveness. By developing the infrastructure to reach people's requirements at the household level and keep up with changing circumstances in all regions of the nation, we will be able to meet their needs continuously. The objective is to reduce Thailand's logistics costs relative to its gross domestic product. Set a target for 2022 that must be less than 12 percent of the original 2020 target of 13.4 and a target to improve the effectiveness of international logistics in Thailand. Which determines the objective value of the Logistics Performance Index (LPI) of Thailand to rank in the top 25 or receive at least 3.50 points by 2022, which is a reflective index that demonstrates the country's potential? Infrastructure and logistics management reflect the nation's competitiveness.

In the most recent 2018 ranking, Thailand was rated 32nd out of 160 countries with a score of 3.41. quantitative and qualitative measurements Thailand has received the following ratings based on the measurement criteria in six categories: 1) Customs formalities the creation of a system for linking data on licenses, certificates, and other documents Related to import-export and logistics processes, scored 3.14 and ranked 36th. 2) infrastructure for transport and information technology upgrading road standards to facilitate cargo transport and developing road networks connecting the 41st principal trading gateway, with a score of 3.14, are objectives. 3) Thailand's international transportation services are more efficient in terms of international transportation planning. With a classification of 25 and a score of 3.46, it is able to meet the rising demand for international shipping as a result of economic expansion. 4) Service provider qualification: AEO (Authorized Economic Operations) is a certificate issued by the Customs Department to certify import-export safety standards. It has been awarded to both government and commercial logistics companies in 2017. Along the cargo route, the 32nd-ranked location earned 3.41 points. 5) Product inspection and monitoring system Transportation and logistics services have increased their use of information technology systems, ranking 33 with a 3.47 score and a 6 on-time service rating. The development of customs procedures can reduce the amount of time

necessary to expedite the import-export process. As shown in Table 2 (Bank, 2018), service efficacy has steadily increased, ranking 28th with a score of 3.81.

Table 2 Thailand's International Logistics Performance Index (LPI), 2018

Composition	score/160	rank (1- 5)
LPI	3.41	32
Customs	3.14	36
Infrastructure	3.14	41
International shipments	3.46	25
Logistics quality and competence	3.41	32
Tracking and tracing	3.47	33
Timeliness	3.81	28

Source: World Bank (2018)

According to the International Logistics Performance Index (LPI), the top five countries for logistics efficiency are as follows: 1) Germany with 4.20 points; 2) Sweden. has 4.05 points 3) Belgium has 4.04 points 4) Austria has 4.03 points 5) Japan has 4.03 points. as shown in Figure 3.
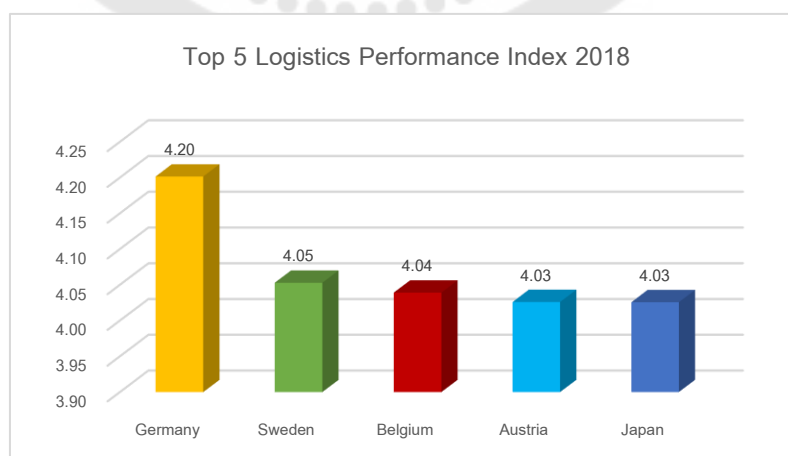
Figure 3 Top 5 Logistics Performance Index (LPI)

Source: World Bank (2018)

The Logistics Efficiency Index (LPI 2018) is a benchmarking tool designed to assist nations in identifying the obstacles and opportunities they confront in their logistics operations. Germany ranks first in terms of logistics efficacy. The current Transport Infrastructure Development Strategy (FTIP 2030) focuses on the construction and maintenance of road transport infrastructure, namely motorways and highways, with an emphasis on the efficient mobility of passenger and cargo transportation resulting from a robust infrastructure. Protection of the environment and pollution reduction.

Second-place Sweden places a high priority on the development of road network infrastructure. It consists of 98,500 km of state roads, 42,500 km of rural municipal roads, and 75,500 km of private roads. Logistics ranks third globally. (Bank of the World, 2018) National Plan of Action Since 2017, the business has been in operation. It is implementing intelligent transport systems to enhance road transport, connectivity with other modes of transportation, and travel quality. Utilize (Intelligent Transport Systems: ITS), the implementation of new technologies in traffic and cargo administration, to reduce travel time. It creates new possibilities for conventional road administration, including maintenance planning and construction. National Strategy for Freight Forwarding It aims to establish conditions for more efficient and environmentally friendly freight transport

In Belgium, road transport infrastructure contributed the most to the added value of the sector in 2015, totaling 3.3 billion euros and accounting for 27.7 percent of the total transport sector. During 2010–2015, the average annual growth rate for road transportation was 1.1%. In terms of infrastructure investment plans, road transport remains the largest sector. end 2017 with an investment ratio of 22,1% (National Bank of Belgium, 2017) due to positive growth in road transport. Investments are made in the construction of a new highway connecting the city to the coast in an effort to alleviate local traffic congestion. It is a new highway that connects the cities and is the missing connection in the network. This endeavor will expedite land conveyance to ports and coastlines.

Austria has an outstanding transportation network and serves as a shipping hub. There is a transport system linking road, rail, and marine transport, a port, and a plan for the development of transport infrastructure. 59 percent of Austria's cargo is transported by road, 37 percent by rail, and 4 percent by water. Austria optimizes the mix of all modes of transport for sustainability, with 59 percent of its cargo conveyed by road, 37 percent by rail, and 4 percent by water transport. In the European Union, only 18 percent of products are transported by rail on average. Austria aims for a 40% mode share and prioritizes rail infrastructure investment to become a transport authority in Europe (Behrendt, 2019).

The building of infrastructure in Japan roads serve a crucial role in society. Improving roads is essential to reducing traffic congestion. greatest failing Increasing the ability to compete internationally and creating a city that is both comfortable and environmentally friendly. The economic policy 1) to improve the flow of transportation in the Tokyo metropolitan area. The Bureau will establish a three-way ring expressway that supports all of Japan's social and economic activities; 2) to construct the backbone of Tokyo's road system. The development of the perimeter road is emphasized. 3) to safeguard the livelihoods and welfare of Tokyo's residents. Enhance the living conditions in urban areas. Develop main roads to facilitate traffic flow in the region. in other regions, including Tokyo's mountains and islands Construction of roads that improve the standard of living of local residents and foster industrial growth. 4) Construction of highways for city planning to increase disaster resistance in the development area, which is likely to sustain severe earthquake-related damage.

Establishes that Infrastructure development has been incorporated into the logistics efficiency development policies of Germany, Sweden, Belgium, Austria, and Japan in order to facilitate the evolution of transport structure changes. utilizing a comparable form of development planning developing the mode of transportation with the greatest proportion of transportation as a base for other modes. It will emphasize the development of road transport infrastructure to facilitate rail, water, and aviation travel. Geography will determine the type of development initiatives implemented in each

country. The objective is to increase competitiveness and potential. The convenience of the country's citizens. To accomplish economic expansion, develop trade that spreads wealth from the city to the countryside.

Thailand consequently intends to improve its transportation infrastructure. The development of logistics and digital infrastructure will be the foundation for national competitiveness. In addition, there is a target value that must be met by 2022, which is to reduce Thailand's logistics costs as a percentage of GDP. Less than 12 percent and improving Thailand's international logistics efficacy. Which determines the Logistics Performance Index (LPI) target value for Thailand to rank in the top 25 or obtain at least 3.50 points. Regarding road transport, the anticipated disbursement of investment in project plans under the 12th National Economic and Social Development Plan (2017-2021) is intended to fund the development of intercity highway construction projects. According to Table 3, a total investment of 254,040 million baht represents 71.67 percent of the road network development.

Table 3 Estimated Disbursement for Road Transport Infrastructure Development Project Plan (Unit: Million Baht

Plan for investment	Investment limit	2017	2018	2019	2020	2021
Road network development	354,458	61,243	94,698	85,078	47,138	19,675
1. Intercity motorway project	254,040	27,264	56,846	72,902	41,434	19,435
Bang Pa-In –Nakhon Ratchasima	(71.67)					
Bang Yai - Kanchanaburi						
Songkhla - Thai border (Malaysia)						
2. Four-lane Road extension project	100,418	33,979	37,852	12,177	5,705	240
	(28.33)					

Source: Office of the National Economic and Social Development Council (2016)

The road transport infrastructure development plan is shown in Table 3 . Thailand is concerned with the advancement of intercity highway construction initiatives. to enhance capability and competitiveness to expand economic activities in order to foster the creation of value additions to be internationally competitive, increase the productivity of the manufacturing and service sectors and reduce the cost of production and services. In the most urgent phase, plan to construct a network of intercity motorways linking Bangkok to other regions. With high travel volume within a radius of 250 kilometers from Bangkok, the entire route to the North, Northeast, South, East, and West, as depicted in Figure 4 , will be high-efficiency transportation routes connecting Bangkok and its environs with other regions from 2013 to 2020.
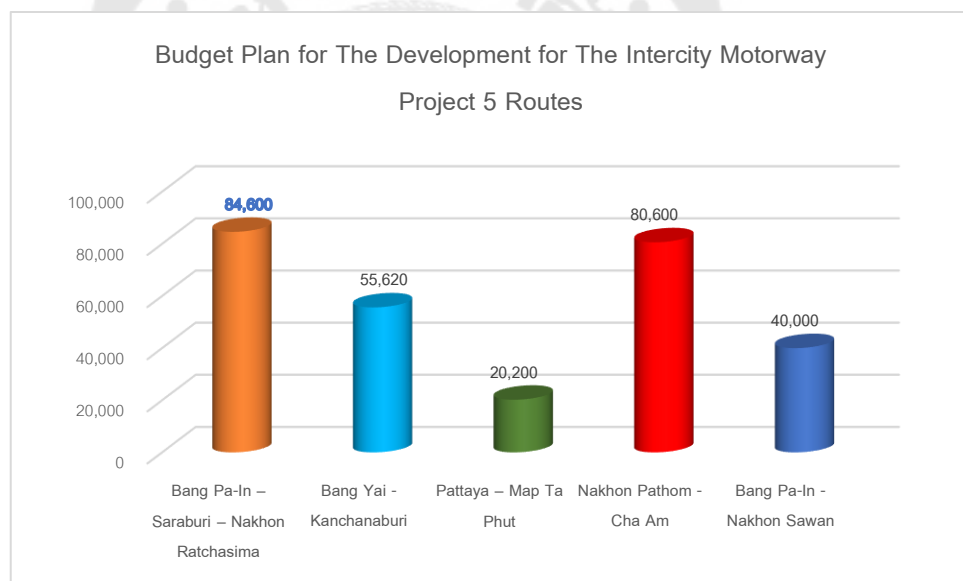
Figure 4 Development strategy for five urgent phases for the intercity highway network

Source: Department of Highways (2021)

The Bang Pa-in - Saraburi - Nakhon Ratchasima intercity motorway project, the Bang Yai - Kanchanaburi intercity motorway project, the Pattaya - Map Ta Phut intercity motorway project, the intercity special highway project Nakhon Pathom - Cha Am, and the intercity special highway project Bang Pa-in - Nakhon Sawan, for a total of 5 routes

by the intercity spec highway project. Or, out of the five projects included in the Ministry of Transport's Action Plan for expediting investment measures, the M6 intercity motorway is the most urgently required project. As shown in Table 3, the projected disbursement of investment in the road transport infrastructure development project plan. and the Ministry of Finance's PPP Fast Track (PPP Fast Track) project acceleration. are intended to expedite the investment of large-scale projects so that tangible results can be realized as soon as possible. The investment with the highest value is 84,600 million Baht, or 30,1% of the entire investment value of the intercity highway construction project.

Interstate Highway Construction Project the Bang Pa-in-Nakhon Ratchasima Line, or Interstate Highway M6, is a proposal for the construction of civil works divided into forty contracts. Bang Pa-in-Nakhon Ratchasima Line The total distance is approximately 196 kilometers, with comprehensive access control. In the east, there is a connection point with Bangkok's outer ring road. (Kanchanapisek Road) The route begins in Bang Pa-in District, Phra Nakhon Si Ayutthaya Province, and ends in Mueang District, Nakhon Ratchasima Province, to the west. There will be intersections at varying levels along the route. There are ten interchange locations to connect the project to main highways: 1) Bang Pa-in 1 Interchange 2) Bang Pa-in 2 Interchange 3) Wang Noi Interchange 4) Hin Kong 5 Interchange; Saraburi Interchange 6) Kaeng Khoi Interchange 7) Muak Lek Interchange 8) Pak Chong Interchange 9) Sikhio Interchange 10) Nakhon Ratchasima Interchange, comprised of nine toll plazas: 1) Bang Pa-In Toll Plaza 2) Wang Noi Toll Plaza 3) Hin Kong Toll Plaza 4) Saraburi Toll Plaza 5) Kaeng Khoi Toll Plaza 6) Muak Lek Toll Plaza 7) Pak Chong Toll Plaza 8) Si Khew Toll Complex 9) The Kham Talay So Toll Plaza offers leisure areas and other amenities. Along the project route, there are eight locations for vehicles, which are divided into three categories: 1) Rest Stops 5 places: Wang Noi, Nong Khae, Thap Kwang, Lam Ta Khong, Kham Talay So 2) Service Area: 2 sites in Saraburi and Sikhio 3) 1 service center in Pak Chong, as depicted in Figure 5 (Highways, 2021).

Figure 5 Route Specifications for the Bang Pa-in to Nakhon Ratchasima Intercity

Motorway Project

Source: Department of Highways (2021)

Urban highway construction the Bang Pa-in-Nakhon Ratchasima line will serve as a link between Bangkok and the heart of the Northeast. A network connecting neighboring countries, namely Laos, Vietnam, Cambodia, and Southern China, with a route beginning at the connecting point connected to the eastern outer ring with Phaholyothin Road at Bang Pa-In interchange in Phra Nakhon Si Ayutthaya Province and a distance of 196 kilometers and a travel time of 127 minutes. Parallel to Phaholyothin Road, Mittraphap Road converges at the second kilometer marker with the Nakhon Ratchasima bypass, Nakhon Ratchasima Province. The route traverses three provinces and twelve districts: Phra Nakhon Si Ayutthaya Province, Bang Pa-in District, Wang Noi District, Uthai District, Saraburi Province, Nong Khae District, Mueang District, and Saraburi Province, Nong Khae District, Mueang District. Saraburi, Kaeng Khoi District, Muak Lek District, Nakhon Ratchasima Province, Pak Chong District, Sikhio District, Sung Noen District, and Kham Thale So District, Mueang Nakhon Ratchasima District It will result in increased transportation-based commerce. Increased employment rates

generate income for the nation. Along with the development of processes and the administration of logistics systems that employ more modern technology, dealing with change is essential. In addition to developing and enhancing the capabilities of the nation's logistics service providers. To facilitate the transport of multimodal products in a manner consistent with the development of areas along the economic corridor as well as the agriculture, tourism, and industry of the country. To improve energy efficiency in the transportation sector and maintain competitive logistics costs within the nation. morally responsible Developing public transportation in Bangkok and the surrounding area, including the region's main cities to encourage the spread of prosperity and the establishment of new economic hubs. in addition to developing a connection to the transportation system to improve the quality of life of the people and stimulate economic development (Office of the National Economic and Social Development Council, 2020).

From the investment value of this construction project, which requires an investment of 84,600,000,000 baht, 30.1% of the total investment value of the intercity highway construction project can be calculated. Consider comparing with anticipated benefits following the construction project's completion. possibly unable to display accurately Should the federal government invest? There are numerous criticisms regarding the effectiveness of such an investment. Or would it be more prudent to invest in other projects and investment in such infrastructure when project-by-project considerations are made. How effective and influential it is on the economy. The evaluation of the economic benefits generated by the construction of intercity highways needs to be improved. Bang Pa-in - Nakhon Ratchasima Clearly, this is required to ensure that these initiatives' substantial costs are justifiable.

A recent national economic impact study examined total expenditures. For each undertaking, a cost-benefit analysis (CBA) technique is applied. It is the most common method for evaluating the economic efficacy of proposed projects. The majority of them are concerned with the direct effects of the undertaking. as a result of cost and time savings (Keegan et al., 2007). Banister and Berechan (2001) cite the broader impact of transportation infrastructure on economic growth and productivity.

State and federal production (Aschauer, 1989; Graham, 2005 and 2006). For these reasons, it is necessary to evaluate the economic impact of the intercity highway project using the most appropriate method. To encompass all dimensions, the Bang Pa-in - Nakhon Ratchasima Line Each sector must ensure that these initiatives are suitable for the investment value, or else they will incur losses in the millions of Thai Baht.

How to evaluate the impact or economic linkage between infrastructure development and the expansion of various sectors with distinct characteristics and forms based on the form of consideration. And to understand the structure of economic growth, it is necessary to apply theory to economic data. that can display the connections between all sectors of the economy Method for evaluating impacts using production factor and output tables. Used to signify interindustry production and the connections resulting from increased demand and consumption in a particular industry, such as transportation

Inputs and outputs tables have been utilized to analyze economic effects and production structures. Ridwan et al. (2015) evaluated the economic value of new infrastructure investments and indirect benefits received from the manufacturing sector (major sector) as a consequence of reduced transportation costs. Analyze the impact and linkage between sectors and economic projections (GDP) by determining the factor coefficient and analyzing the backward and forward linkage multipliers. Investments in road infrastructure have a positive impact on the manufacturing sector and the macroeconomic level by lowering the cost of transporting products (distribution costs). Contributes to the economic effectiveness of the region. from reducing the cost of transporting products between cities and regions There are two methods for analyzing the economic impact of various transportation investments, namely price analysis and cost-benefit analysis. (Change in the value added or unit price of a specific industry's output) and production projections. (Change in the final demand of a specific industry) as a result of prospective sources of economic change. Focusing on new transportation investments, it was discovered that transportation investments have altered the cost of business transportation. Affecting the output price levels of various sectors. Existing

industries expand as a result of alterations in consumer demand. The decline in corporate expenses Changing Business Transport Service Requirements It is believed that new transportation investments will stimulate demand for various transportation services. Supports the idea that infrastructure investment should be contingent on economic development. (Michael and Jian, 2010)

All of the preceding It demonstrates that transportation infrastructure development influences economic growth. And to execute the plan to enhance the organization's potential and competitiveness. become a nation with a high level of logistical effectiveness, and complete the intercity highway project. Bang Pa-in - Nakhon Ratchasima Line Linking Bangkok to the Northeastern region, it is an essential, urgently required, and top priority project. with heavy passenger volume Up to 30.1 percent of the total expenditure for road transport infrastructure development was utilized. To evaluate the effectiveness of the government's decision to invest in such initiatives. Or would it be more prudent to invest in other projects? and investment in such infrastructure when project-by-project considerations are made. This study was necessitated by the need to determine its efficacy and economic impact. Examining and analyzing the transportation infrastructure development policies of other nations in order to comprehend their policies, actions, and development patterns and to evaluate their economic impact. Examine the relationship between sectors and economic forecasts. Utilizing the table of production and output factors (Input-Output Table) by locating the factor coefficient and analyzing the backward linkage multiplier and forward linkage multiplier in order to determine the impact of the production sector. to draw a conclusion regarding the direction of the impact of government expenditure on the intercity highway project. Bang Pa-in - Nakhon Ratchasima Line This allows the government to invest in transportation infrastructure suited to the problem. precisely which sectors should be subsidized before or after.

Objectives of the study

1 . Examine and compare the evolution of transportation infrastructure in Thailand and abroad. Germany, Sweden, Belgium, Austria, and Japan.

2 . Analyze the economic impact of the Bang Pa-in - Nakhon Ratchasima intercity motorway project.

Significance of the research

1 .The objective of this study is to compare the development of transportation infrastructure in preparation for economic expansion. Enhance capability and competitiveness Consequently, Thailand's logistics costs as a percentage of GDP are less than 1 2 percent, and Thailand's international logistics efficiency has increased. Which determines the target value from the Logistics Performance Index (LPI) of Thailand to rank among the top 25 or achieve at least 3.50 points based on the structure investment policy. Base in Germany, Sweden, Belgium, Austria, and Japan, which are the top five countries with the highest logistics efficiency index, and analyze the development of Thailand's transport infrastructure as a basis for infrastructure development planning in Thailand.

2. Economic Impact Study Results of a study on the relationship between sectors in the supply chain of the Bang Pa-in - Nakhon Ratchasima Line intercity highway construction projects and other production sectors in the country. Incorporating the domestic sector, the government sector plans policies to promote and support economic sectors, resulting in policy recommendations. This enables the planning of investment policies for transportation infrastructure that address the problems. Which industries should be supported most effectively.

Scope of study

This research has determined the research scope based on the research objectives, which has been divided into two parts:

1. Development of infrastructure for transit in Thailand and abroad

A study and analysis of the nation's infrastructure development policy for transportation. By analyzing past investments in transportation infrastructure and the 12th National Economic and Social Development Plan (2017-2021), this report aims to provide a comprehensive understanding of the nation's economic and social

development. Strategy 7 Infrastructure and logistics system development Focusing on the improvement of transportation and network infrastructures. administration of telecommunications and infrastructure to support Germany, Sweden, Belgium, Austria, and Japan's policies on the development of special economic zones, urban areas, connecting travel, and transporting products between countries, and transportation infrastructure. To examine approaches and issues deriving from long-term plans for road infrastructure development for various factors, Germany, Sweden, Belgium, Austria, and Japan were selected. The logistics efficiency index is comprised of the top five countries based on their logistics efficiency rankings. The 2 0 1 8 International Logistics Performance Index (LPI) is a benchmarking instrument designed to assist nations. To comprehend the challenges and opportunities confronting logistics operations and trade, as well as to enhance logistics efficiency. Both qualitative and quantitative measurements of global ground service (shippers and express carriers) Measuring logistics supply chain efficacy Both nationally and globally (The World Bank, 2018). The efficacy of a country's logistics stems from the efficacy of its transportation, which is determined by its transportation infrastructure. The development of the communication network is favorable.

2. Analysis of the Intercity Motorway Project's Economic Impact the Bang Pa-in – Nakhon Ratchasima line consists of the following stations:

An analysis of the relationship between sectors in the Bang Pa-in - Nakhon Ratchasima Line intercity highway construction supply chain and other production sectors in the country. Using the input-output table of the 2015 edition of the data set, with a 180 x 180 matrix, the economic sector applies the Leontief Multiplier to determine the coefficients of direct and indirect inputs and outputs, calculates the factor coefficient, and examines the backward linkage multiplier and forward linkage multiplier.

Assess the economic impact of the intercity highway construction commitment. Analysis of the Bang Pa-in - Nakhon Ratchasima Line's sector of construction, employment, and factors that stimulate the economy After analyzing satellite images of nighttime lights, the project will acquire primary data. Conduct in-

depth interviews with Intercity Motorway Project participants. Three sectors comprise Bang Pa-in - Nakhon Ratchasima: government agencies, the private sector, and households.

Definitions

    1. **Input-Output Table (I-O Table)** is a table that illustrates the connection between production and product consumption. Consumed for both final (Final Use of Goods and Services) and intermediate purposes. (Intermediate Consumption), where intermediate consumption is a crucial component of the Table of Production Factors and Outputs. Because it illustrates the relationship between industries in the economy, the 2015 dataset, 180 x 180 matrix dimension, is significant.

    2. **Forward linkage multiplier** is implying direct forward linkage, which describes the distribution structure of the branches involved in the intercity highway construction project. In what proportion has the Bang Pa-in - Nakhon Ratchasima Line's production been distributed to various economic sectors for use as a factor in production.

    3. **Backward linkage multiplier** is a direct bard linkage that indicates to the factor use structure of one economic sector that it must rely on production factors from other economic sectors. how proportional.

    4. **Economic Impact** refers to the effect of the construction of intercity highway initiatives on the connection between sectors in the supply chain. Bang Pa-in - Nakhon Ratchasima Line Structural Path Analysis of the construction industry, branch code 1 4 1 , employment, economic stimulants, and economic impact directions of the intercity motorway project. Bang Pa-in - Nakhon Ratchasima Line.

    5. **Night Time Light: NTL** is a phenomenon that results from the nighttime use of electricity by all sectors. both from residential electricity usage Industry, transportation, numerous business groups, and the public power grid.
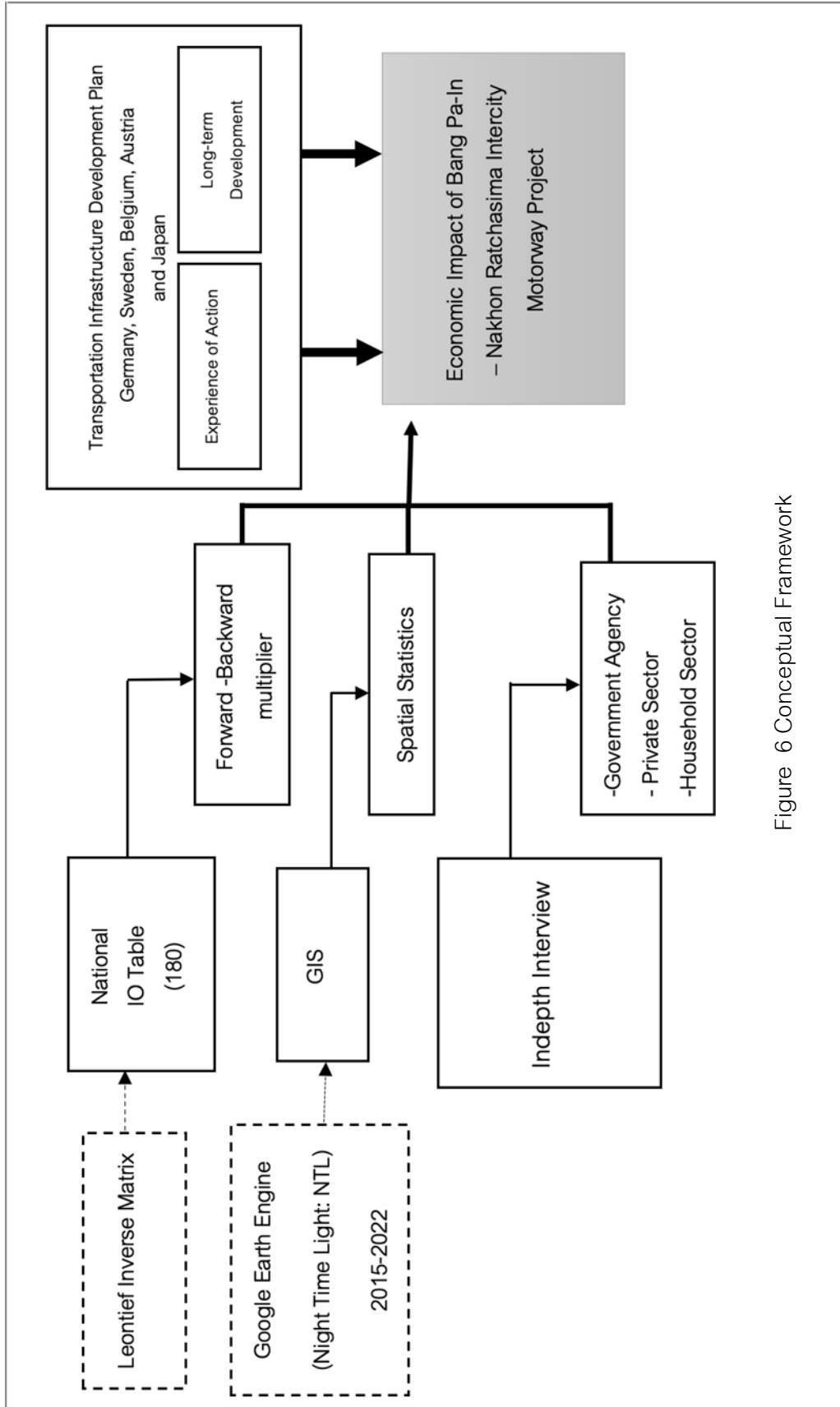
Figure 6 Conceptual Framework

Source: Determined by the researcher

Conceptual Framework

Evaluation of the Bang Pa-in - Nakhon Ratchasima Line Intercity Motorway Project's economic impact It is an assessment of the effect that investment decisions have on government revenue. Consider the effect of the project's nature on the project's economic impact. Under strategic issue 7 of the 12th National Economic and Social Development Plan, the objective is to reduce Thailand's logistics costs as a percentage of its gross domestic product to less than 12 percent, and to increase the efficacy of Thailand's international logistics. Which determines the Logistics Performance Index (LPI) objective value for Thailand to be in the top 25 or have a score of at least 3.50 points.

The study consisted of a comparison between the 12th National Economic and Social Development Plan, 7th Strategic Issue, and the Group's road network development infrastructure development plan for Thailand's transport infrastructure road network development. The five nations in question are Germany, Sweden, Belgium, Austria, and Japan. and research related to the development of road infrastructure and its economic impact. This is an example of a lecture on Thailand's long-term development planning that emphasizes analysis. as well as the long-term economic effects of development initiatives. In conjunction with the study of the linkages within the economic system affecting the upstream sector (Backward multiplier) and the linkages affecting the downstream industry (Forward multiplier) related to the construction of the expressway between city Bang Pa-in - Nakhon Ratchasima Line using the table of factors of production and output (Input-Output Table) of Thailand, 2015, size 180 production fields, the back and forward multiplier matrix of Leontief was calculated. and analyze the network of transmission routes of the impact of construction sectors within various sectors of the economy's production expansion link using satellite data and geospatial data to determine economic expansion. Changes in the economy caused by the construction of the intercity motorway initiative. The Bang Pa-in - Nakhon Ratchasima line incorporates satellite-detected night time light data (Night Time Light: NTL) and socio-economic variables, namely provincial products, in order to evaluate the impact of

the intercity highway project. The direct Bang Pa-in - Nakhon Ratchasima line is constructed with the participation of representatives from government agencies, the private sector, and the domestic sector. From the three investigations, the economic impact of the intercity highway construction project was determined. Bang Pa-in - Nakhon Ratchasima Line To understand the long-term effects that will result from the development of road infrastructure in Thailand.

Chapter 2

Related Literature

Review of literature pertinent to this investigation the researcher has reviewed pertinent documents and conducted research in order to present the following topics.

1. The theoretical concepts utilized in the research

1.1 Table of production and output factors (Input-Output Table)

1.2 The relationship between satellite data and geospatial information and economic expansion

2. Related studies

1 Theoretical Concepts

The study's methodology for evaluating the economic impact of the Bang Pa-in - Nakhon Ratchasima Line intercity highway project was based on economic theory. Regarding the relationship between the economic sector and the economic outlook for the Northeast region the relationship between economic growth and satellite data and geo-informatics, as represented by a table of input and output factors (Input-Output Table). The specifics are listed below.

1.1. Input-Output Table

The table of production components and outputs is a type of accounting system that compiles data in order to have a better understanding of the connection that exists between production and production utilization. Was conceived of and developed by Leontief in 1936 by separating production in the production system into production sectors or industries which each specialized in a certain aspect of the production process. At a minimum, one business unit constitutes each of the manufacturing departments. Its purpose is to generate goods that are comparable to one another but which are not necessarily exactly the same. each individual sphere of manufacturing Either the final use of goods and services, or the consumption of goods and services at an intermediate level, both require the acquisition of products and services from other

branches. (Consumption of Intermediate Materials) Because it serves as a connecting point for many subsets of the manufacturing industry, intermediate consumption occupies a pivotal position in the table that summarizes the elements that influence production and output. In the economy as a whole as a result of the fact that each production sector sells the goods and services it produces to other production sectors.

Analysis of input-output tables (Input-Output Analysis) was initiated by Leontief and published in 1 9 3 6 in Anglo-America. Quantitative Input and Output Relations in the Economic System of the United States, published in the Journal Review of Economic Statistics, is the result of Leontief's work at Harvard University. This was thoroughly explained and analyzed in a 1931 and 1941 book titled. The Structure of the American Economy, beginning with the analysis of inputs and outputs tables. Assumes the economy is a closed system (Closed Economic System) describes an economy where all goods are intermediate goods. (Intermediate Goods) and the goods produced in the economy must be used to produce other goods for the economy to be in equilibrium. Equilibrium occurs only when each output is sufficient to satisfy the demand for the inputs of the product. Including all other territories. The economy should be an open system in which the final demand is externally determined (Opened Economic System). Therefore, analysis of the inputs and outputs table is required. The objective is to determine the level of activity in various economic sectors in accordance with the predetermined final demand.

Since more than 5 0 years ago, tables of production factors and outputs have been created for Thailand. Dr. Wichitwong Na Pomphet created the first table of production factors and outputs in 1951, which is the first edition of the matrix dimension. 3 3 and has continued to develop until Thailand was able to create the most comprehensive table of production factors and outputs at that time, namely the 1 9 7 5 edition of the table of production factors and outputs, which was the result of the collaboration of four institutions, namely The Institute of Developing Economics of Japan (IDE), Office of the National Economic and Social Development Board National Statistical Office Faculty of Economics and Social Research Institute Chula. The

economic flow table (Flow Table) is a table that depicts the flow of production factors and output from various sectors. Which has four components. The first section has a pattern in terms of the production distribution of a particular branch, but the inputs and outputs can be modeled for any production sector in the economy. represents the movement between production factors and output or the demand for intermediate goods and services used in the production of goods and services in each production sector (Transaction Table). The second section represents the added value (Value Added) of each production sector, which consists of rent, wages, labor, interest, and profit. The third section represents the value of each sector's final demand (Final Demand), which is comprised of household consumption, investment, government expenditure, and exports. In the input-output model, the fourth component represents the entire value of the output of each economic sector.

In creating the Production Factors and Outputs Table Since 1980, the Office of the National Economic and Social Development Board has operated as a joint working group comprised of agencies and university experts involved in the production of preliminary data. "Working Group for Creating Tables of Production Factors and Outputs" is the formal title. This working group reports directly to the National Economic and Social Development Board. Brief (Short-Cut Method) is to update the data from the 1975 table to be current only (also known as the Updating Method), i.e., primarily uses the structure of the 1975 table, along with the data from the revenue account. And it was discovered that the data from 1975 was insufficient when contemplating, for instance, which sectors of production are likely to undergo substantial changes in their production structure since 1975. high and yielding limb the production structure of industries in that sector will be investigated further with a total of 100 samples, after which the survey results will be processed and reconciled. (Reconciliation) to balance the table, this 1980 table is the same dimension as the 1975 table, i.e., 180x180, with a production field and three sub-tables measuring 58x58, 26x26, and 16x16.

For the Production Factors and Outputs Table 1982, the Office of the National Economic and Social Development Board, the Chulalongkorn University Social

Research Institute, and the National Statistical Office collaborated on a study of the economic impact of oil price fluctuations. Specific to the production sector is the need to disaggregate the energy sector in greater detail, particularly the production sector associated with oilseeds and animal feeds for the construction of economic models of oilseeds and animal feeds, as well as related industries.

Table of Production and Output Factors Division of Economic Analysis and Forecasting, 1982 The Office of the National Economic and Social Development Board is a joint initiative consisting of the formation of a subcommittee to prepare tables, which was established with the cooperation of government agencies and private sectors involved in collecting and preparing preliminary data. Production factors and output, as well as the central working group responsible for compiling the table of production factors and output. In addition, a working group has been established within the planning subcommittee to examine the results of the table of production factors and output for Thailand in 1985. This can be useful in the preparation of economic models if it is included in order to accomplish the goals. The table for 1985 in the Seventh Plan (macroeconomic model) is the ideal example of a table. (Comprehensive) with dimensions 180×180, the field of production, whose primary purpose is to cover new products that have increased production, such as natural gas, gas separation plants, and to highlight changes in the production structure or technology, including changes in prices that affect technical input coefficients, as well as changes in the structure of output distribution, in the national economy, as well as to serve as tools and databases for analyzing these changes, collective and economic planning.

In addition, the Division of Economic Analysis and Estimates of the Department of Production and Production has also prepared a table. Factors of Production and Output, 1989, to be utilized in the compilation of the country's economic model for the 7 th National Economic and Social Development Plan by developing a short-cut method with 27x27 study fields. Manufacture.

One method to systematize the nation's economic activities. By categorizing these activities based on the type of sector or industry, such as agriculture, mining,

industry, transportation, construction, and service, and by adding assumptions to this concept. Systematically, it can be used to construct a table illustrating the production and distribution of goods and services in a country's economy over a period of time. In addition to selling their inputs to households, governments, and foreign businesses, production sectors must also supply other sectors with their inputs for use as factors of production in the production of other commodities.

Inferentially, factors of production and output represent the flow of commodities and services between various sectors of the economy over a specified time period. The vertical (column) side of the table displays the input structure, whereas the horizontal (row) side displays the distribution or distribution of output (output distribution) for each input structure. The economic sector of production and the statistics of inputs and outputs may also be referred to as the economic sector of production. Table of inter-industry relations.

In order to analyze changes in the structure of the economy, the National Economic and Social Development Board will compile and publish a table of Thailand's production factors and output. It can be used to evaluate the impact of events on economic changes (economic impact analysis) or to assess the macroeconomic impact in terms of economic stimulus and large-scale investment.

The structure of the inputs and outputs table

During preparation of the inputs-outputs table, the following assumptions must be made:

1. Production-related raw materials are presumed to be identical if they are used in the same sector, but not in other sectors.

2 . It is considered that the raw materials used in production are consumed in a fixed proportion, that there are no economies of scale and that other raw materials cannot be substituted; therefore, the price is always constant. Therefore, a rise in demand automatically results in a rise in employment.

3.The primary source of production motivation is demand, including private consumption, private investment, and net exports. Because machines and labor

are always underutilized, the economy can produce products instantly or the manufacturing sector can react immediately.

4 . Since the national account must be well-established and always balances revenues and expenditures, the data from the inputs and outputs tables are dependable and linked to other macro data.

Despite the fact that using the inputs and outputs table is not optimal. Because it has a more comprehensive social matrix profile. However, it can perform tasks that econometric models cannot, such as determining if the production of this product will increase the number of beneficiaries or identifying which phases of production may be problematic. The output is inadequate for supplying an industry or similar. The structure of the inputs and outputs table is depicted in Table 4 based on the concept of the table of production factors and outputs mentioned previously.

Table 4 The structure of the inputs and outputs table

		Intermediate Demand			Final Demand	Total Output
		X_1	X_2	X_j	(F_i)	(X_i)
Intermediate Transactions	X_1	X_{11}	X_{12}	X_{1j}	F_1	X_1
	X_2	X_{21}	X_{22}	X_{2j}	F_2	X_2
	...	...	...	...	...	...
	...	...	...	...	...	...
	X_i	X_{i1}	X_{i2}	X_{ij}	F_i	X_i
Value Added		V_1	V_2	V_j		
Total Input		X_1	X_2	X_j		

Source: Miller and Blair (2009)

From Table 4, the structure of production factors and output Following is an explanation of the table of factors of production and output.

The values in the table of production factors and outputs in the main line (Column) characterize the use of the main line (Column). Composed of the factors of production and output of each discipline of production are:

1) Intermediate production variables (X_{ij}) is the product of the branch of production of good i that is used as the factor of production of good j, which can be described using variables from the table; for instance, X_{21} is the value of the second type of product that is Used to produce good type 1 with value X_{21}.

2) Value Added refers to fundamental production parameters. In addition to intermediate factors of production used as factors of production in any sector, such as wages, interest, land, and taxes, there are also final factors of production.

Considered horizontally (Row), the values in the table of inputs and outputs in the main direction describe the Distribution of products and services in each production field in order to meet the requirements of other production fields and final demand, which includes

(1) Intermediate Demand is synonymous with demand. Use products and services from sector i as factors for sector j, which can be explained using table variables; for instance, X_{21} is the value of sector 1 that sector 2 must consume.

(2) Final demand refers to the demand for products and services from sector i that are not utilized in subsequent production, such as household consumption. Changes in inventory, exports, etc.

On the basis of Leontief's formula of production factors and output, the properties of mathematical equations and matrices have been determined. the relationship between production branches was described. Assuming there are n production branches, the output distribution of the i branch is depicted as horizontal rows:

$$X_1 = X_{11} + X_{12} + \dots + X_{1n} + F_1 \qquad \dots (1)$$

$$X_2 = X_{21} + X_{22} + \dots + X_{2n} + F_2 \qquad \dots (2)$$

$$X_n = X_{n1} + X_{n2} + \dots + X_{nn} + F_n \qquad \dots (3)$$

Or $\qquad X_i = \sum_{j=1}^{n} X_{ij} + F_i \qquad$ By (I = 1, 2,......,n)

By $\quad X_i$ is the total production value of production branch i or the output value that must be produced to meet industry demand.

X_{ij} is the production turnover of branch i for the production of branch j's products.

F_i is the final demand for output from the i field of production.

similarly, the primary line represents the production branch j's cost structure.

$$X_1 = X_{11} + X_{21} + \text{......} + X_{n1} + V_1 \qquad \text{.............(4)}$$

$$X_2 = X_{12} + X_{22} + \text{......} + X_{n2} + V_2 \qquad \text{.............(5)}$$

$$X_2 = X_{12} + X_{22} + \text{......} + X_{n2} + V_2 \qquad \text{.............(6)}$$

or $\qquad X_i = \sum_{j=1}^{n} X_{ij} + V_j \qquad$ โดยที่ (I = 1, 2,......,n)

by $\quad V_j$ is the value added of all outputs from the j sector of production, such as labor wages, rent, profits, or interest, etc.

Assumptions of Production Input and Output Tables

(1) The factor of production and output coefficients are constant, indicating that the proportion of factors utilized in production remains unchanged.

(2) Production technology must have a constant return to scale; if the production of goods is required to double, the factor of production of goods must increase.

Double the exterior and interior no economies of scale, both exterior and interior.

(3) Sectorialization of economic activities Merging activities into one branch must occur without error, i.e., production activities in the same branch must be comparable. Moreover, separate production fields must be of distinct types, and a single production field cannot involve co-production. Types of inputs and output tables.

The table of production and output factors is divided into two groups:

1) Purchaser's price table refers to factors of production and output measured at actual traded prices in the economy, transportation costs included.

2) Producer's price table refers to a table of factors of production and output that is measured at the site of production in order to determine the true cost of producing goods. At producer costs, three additional matrices are required.

1. Wholesale trade margin matrix

2. Retail trade margin matrix

3. Transport cost matrix Therefore, the table of elements of production and output at producer prices is as follows, based on the transport cost matrix:

Producer price table = Buyer price table – Trade margin table – Transportation cost table.

Classification of fields of production

Classification criteria for industrial sectors Throughout the creation of the 1990 Table of Production Factors and Outputs, all economic activities are categorized. The "Thailand standard industrial classification" (Thailand standard industrial classification) has classified the production sector into 180 production sectors according to this 1990 table.

Price Prediction

1) Product price measurement The output price of the *1990* Table of Factors of Output and Output is measured as follows.

Product Price Evaluation For agricultural products, ex-farm prices are used, while ex-factory prices are used for industrial products. These prices include net indirect taxes but exclude trade margins. Transportation.

In the forestry, fishing, mining, and mining sectors, where the price at the point of production cannot be determined, the market price close to that point of production is used to calculate the value of the produce, and the cost of transport from the point of origin to the market is included in the calculation. At that price, it is also considered a production expenditure.

For goods that the producer retains for own consumption, such as agricultural products, the valuation will use the producer price (Producer's Price) in the calculation; this price will include operating surplus but will not include. selling expenditures.

Variations in completed products inventory Those involved in the production process also utilize the price. The valuation price is the midpoint between the beginning and end of the year.

Military sector the output's value is determined by the price paid by another branch to the service branch. For government or nonprofit service departments. The output value is derived from the complete number of expenditures.

2) Pricing of goods used in the manufacturing procedure Buyer's price and producer's price Buyer's price and producer's price (purchaser's price and producer's price) to determine the price of goods used in the production process using the buyer price from the buyer price table. in addition to the manufacturer data the manufacturer's suggested retail price does not include shipping costs.

In the table of import and export prices (Import and export price), the value of exported products is the free on board (f.o.b.) price. In the table, the transportation costs are subtracted from the f.o.b. price to determine the manufacturer's price. The c.i.f. price for both the producer and the customer will be the total import c.i.f. amount plus import duties, or additional customs, trade, and import duties.

Special Documenting

special recording It includes the following essential items

1) State activities The government's products and services can be divided into two categories: The first type is marketed to businesses and consumers; Public goods that provide free public services and state-prepared products and services for sale on the market must have the same market value as private businesses. For public services such as local administration, the product value equals the property depreciation value plus wages, salaries, or compensation.

2) Valuation There will be valuation. If the item has no information recorded, If the valuation is not performed, the result of the calculation will be underestimated, such as the valuation of one's own residence, the consumption of one's own products and services, one's transportation, etc. These factors will also be evaluated in the Production Factors and Outputs Table in 1990

special commerce branch

A special branch has been established in the Inputs and Outputs table for the purpose of table balancing. The special trade sector consists of unprocessed goods, imported and exported goods that are not listed in the foreign trade statistics of the Customs Department. Items in the special trade sector include tourist expenditures in foreign countries, expenditures by international organization or embassy officials, smuggled or exported goods, and other items of a similar nature.

Documentation of imported products

In general, there are two methods to record imported goods in the inputs and outputs table: competitive import and non-competitive import. The quality of imported goods will be the same as that of domestically produced goods. Therefore, the inventory of imported goods is recorded alongside the goods produced in the country of origin for each item. Non-Competitive Import Method Assumes the Goods Are Uncompetitive Since imported goods are entirely distinct from domestically produced goods, the imported goods log is maintained separately from the domestically produced goods log.

Since it is also necessary to create a matrix of imported goods in the process of preparing Thailand's table of production factors and output, both types of imported goods are recorded. When this matrix is subtracted from the matrix of the table at producer prices, which is a competitive import record, the matrix of domestic production and the matrix of imported goods are plainly distinguished. regarded as a Non-Competitive import recording.

Leontief Multiplier

Table of coefficients of direct and indirect factors of production

is a value that represents the ratio of the output of a branch of production used as a factor in the intermediate production of another branch to the total output of that branch. Calculating the production and output coefficients under the assumption that a_{ij} is the production and output coefficient or technical coefficient yields the form of matrix A for the production and output coefficients. The following equation for the use of production factors (Input) is directly proportional to the output value:

$$a_{ij} = \frac{z_{ij}}{x_j} \qquad \qquad \text{............(7)}$$

by Z_{ij} is the value of one production branch

X_j is the total output value of that production branch

From the aforementioned relationship, it can be written in the form of an equation as follows:

$$AX + F = X \qquad \qquad \text{............(8)}$$

can write equations to be in the form of a matrix as follows

$$A = \begin{bmatrix} a_{11} & a_{12} \dots & a_{1n} \\ a_{12} & a_{22} \dots & a_{2n} \\ a_{n1} & a_{n2} \dots & a_{nn} \end{bmatrix}, \quad X = \begin{bmatrix} x_1 \\ x_2 \\ x_n \end{bmatrix}, \quad F = \begin{bmatrix} f_1 \\ f_2 \\ f_n \end{bmatrix}$$

$$X = AX + F \qquad \qquad \text{............(9)}$$

$$A = \begin{bmatrix} a_{11} & a_{12} \dots & a_{1n} \\ a_{12} & a_{22} \dots & a_{2n} \\ a_{n1} & a_{n2} \dots & a_{nn} \end{bmatrix} \quad A \text{ is the coefficient of production and output}$$

$$X = \begin{bmatrix} x_1 \\ x_2 \\ x_n \end{bmatrix} \qquad \text{and} \qquad F = \begin{bmatrix} f_1 \\ f_2 \\ f_n \end{bmatrix}$$

$$I = \begin{bmatrix} 1 & 0 \dots & 0 \\ 0 & 1 \dots & 0 \\ 0 & 0 \dots & 1 \end{bmatrix} \quad I \quad \text{is identity Matrix}$$

The relation in Equation (9) can be rearranged by moving the side of the $A\mathrm{X}$ term to the same side as X and rearranging the equation using parentheses.

$$X - A\mathrm{X} = F \qquad\qquad\qquad\qquad \text{............(10)}$$

$$(1 - A)X = F \qquad\qquad\qquad\qquad \text{............(11)}$$

Then, when adjusting the equation again by adjusting the term $(1 - A)$ on the other side of the equation the relationship is obtained as shown in Equation (12).

$$X = (1 - A)^{-1}F \qquad\qquad\qquad \text{............(12)}$$

The value $(1 - A)^{-1}$ shown in Equation (12) is the direct and indirect factor coefficient. The value describes the difference between one production branch and another. How are they related and connected in the use of production factors and outputs? What is the proportion of receiving or passing on the produce to other branches? It also indicates the expansion rate of their own manufacturing sectors, affecting the expansion or contraction of upstream or downstream industries as well.

Backward and Forward Multiplier of Leontief Analysis

After obtaining a table of direct and indirect input coefficients from invert $(1 - A)$ or $(1 - A)^{-1}$, the reverse and forward multipliers for the Lyon Tiaf algorithm can be determined. According to Table 5 , the horizontal sum is the reverse multiplier and the vertical sum is the forward multiplier.

Table 5 Backward and Forward Multiplier Table (1 – A)

		Forward Multiplier →					
	Output	1	2	3	...	n	
Input							
Backward Multiplier ↓	1	X_{11}	X_{12}	X_{13}	...	X_{1n}	$\sum Row_1$
	2	X_{21}	X_{22}	X_{23}	...	X_{2n}	$\sum Row_2$
	3	X_{31}	X_{32}	X_{33}	...	X_{3n}	$\sum Row_3$

Table 5 (cont.)

Forward Multiplier
$\longrightarrow$

	Output	1	2	3	...	n	
Input							
Backward Multiplier ...		...	...	...	...	...	
n		X_{n1}	X_{n2}	X_{n3}	...	X_{nn}	$\sum Row_n$
		$\sum Col_1$	$\sum Col_2$	$\sum Col_3$	...	$\sum Col_n$	

Source: Miller and Blair (2009)

The value of the backward and forward multiplier represents the entire proportion by which one production branch receives inputs for production from all upstream industry branches. specified in the table of production and output determinants Simultaneously, the forward multiplier represents the total proportion of one production branch's influence on the factors of production utilized in the production of all downstream industries. In accordance with the table of production factors and output. that implies The greater the multiplier's value, the greater the proportion of receiving or transmitting production factors. It demonstrates the degree of influence and interdependence these sectors have on other production sectors.

1.2 The relationship between satellite and geospatial data and economic progress.

Utilizing satellite data and geoinformatics to ascertain economic growth or changes resulting from the development of intercity highway projects. Light index data at night or Night Time Light (NTL) is data obtained from two satellites orbiting the Earth at different times between 1 9 9 2 and 2 0 1 4 , utilizing data from The Defense Meteorological Satellite Program (DMSP) utilizing OLS (Operational Line System). scan System), also known as DMSP/OLS, and after NASA launched the SNPP satellite with the VIIRS (Visible Infrared Imaging Radiometer Suite), also known as SNPP/VIIRS, with

detailed satellite imagery. Since 2 0 1 1 , when higher-quality satellites entered Earth's orbit, SNPP/VIIRS data have been utilized.

The concept of Nighttime Light (NTL) photography

Definition and significance of night photography Photographs of night lights depict the electrical energy consumption behavior that occurs. From the activities of humanity on the surface of the Earth at night, such as industry and transportation, night activities can be defined as: It is detectable by the Suomi National Polar-orbiting Partnership Satellite System VIIRS (Visible Infrared Imaging Radiometer Suite) and precludes meteors, the northern lights, and the southern lights. Forest fires assemble to assess the composition.

VIIRS (Visible Infrared Imaging Radiometer Suite) is a mission of the Suomi National Polar-orbiting Partnership System of the NASA National Polar-orbiting Partnership. Under the mission title Joint Polar Satellite System (JPSS, a collaboration between NOAA and NASA), cutting-edge technology is being utilized. represents scientific advancement The Visible Infrared Imaging Radiometer Suite is an instrument of the Moderate Resolution Imaging Spectro radiometer sensor system, which monitors global environmental forecasts and global surface heat spots daily in 2012 by analyzing data from Terra and Aqua satellite images. Therefore, satellites are effective at detecting hot areas on the earth's surface. Data downloaded from the National Oceanic and Atmospheric Administration's (NOAA) Soumi National Polar-orbiting Partnership satellite's Visible Infrared Imaging Radiometer Suite (NPP-VIIRS) system is one economic application of satellite imagery of nightlights. It is stated that the use of satellite images is a form of Machine Learning because it converts data from photographs into pixel-based numbers that can be displayed. As an alternative variable for measuring urbanization, light intensity (Light Intensity) will be used. Calculated from the value of the color intensity in each image point (Pixel) of the night lighting satellite image. The term for this is Digital Number (DN). The Digital Number ranges from 0 to 63, with 0 indicating an area with no illumination whatsoever. As a result of the relatively large quantity of light used for operation, urbanized regions will also have a high level of

light intensity. undertake various economic activities as a result of the lack of economic activity at night, illumination levels in the majority of rural areas are relatively low. Thus, nocturnal light intensity values derived from satellite images can be used to quantify urbanization change. Quantitative information, as represented by the Digital Number value, is the most prevalent type of data. Therefore, it can reflect the difference in urbanization levels between areas, as well as the change in urbanization over time (Over Time). (Mullainathan & Spiess, 2017)

Methods for determining the association between socioeconomic variables and satellite and geospatial data

A correlation to estimate variables from satellite data and geo-informatics with various socio-economic variables of interest, using either simple correlation or Pearson correlation methods, which provide statistical values, is a tool for determining the relationship between socio-economic variables and satellite data and geo-informatics. Using this methodology, researchers such as Roychowdhury and Jones (2014) and Xie and Zhou (2014) (Roychowdhury & Jones, 2014; Xie & Zhou, 2014)have sought correlation with NTL. Estimates can be obtained as linear equations with constant terms by examining NTL from the research of Chen and Nordhaus (2019)(Chen & Nordhaus, 2019), Zhao et al. (2019), and Youneszadeh et al. (2015), among others. This may be an adequate number of years or months for NDVI research found in the work of Jin et al. (2008) and Sun et al. Due to the geospatial (or GIS) nature of the study data, a number of studies have sought spatial statistics by establishing Global Moran I, which represents the importance of data clustering in some regions. The LISA (Local Indicators of Spatial Association) tool was then used to display the concentration areas of the NTL index, as well as the statistical confidence level (p-value) of such clustering characteristics, e.g., occurrences of a particular clustering characteristic. Kulkarni et al. (2011) investigated the connection between NTL and sub-regional economic development in China, India, and the United States. Li et al. (2013) investigated the relationship between China's NTL and home prices.

2. Related studies

The review of research relevant to this study consisted of two themes:

2.1 Development of transport infrastructure

2.2 Economic Impact Analysis

2.1 Development of transport infrastructure

The interaction between transportation infrastructure and economic development continues to be one of the most influential and dynamic. The development of transportation infrastructure has resulted in the expansion of the manufacturing sector, resulting in increased employment and economic expansion. Transportation will have the greatest impact on sustainability. especially essential to the nation's development the utility and significance of the transport infrastructure contributes to the expansion of a country's production capacity by increasing the aggregation of available resources (Raghuram, 2001), thereby fostering sustainable development. Beginning with the transportation infrastructure, it is possible to engage the production process more quickly and directly. It serves as an access point to other transportation routes. available more with efficient road transport, products can be delivered to the market in less time. Help reduce the transmission of production-related transportation costs. This infrastructure can serve as a magnet for regional economic development (Gramlich, 1994; Ramanathan & Parikh, 1999).

Education on the economic effects of infrastructure development in numerous regions in most African economies, impact studies, such as infrastructure deficits, increase the cost of doing business by at least 2 percent per year. Alternatively, if sustainable transportation infrastructure is invested in. If infrastructure was adequate, an additional 1 percent would increase GDP per capita growth by 0.6 percent. Investing in road transport infrastructure can enhance the private sector's productivity by up to 40 percent in Africa (Ondiege, Moyo, & Verdier-Chouchane, 2013), per Ondiege & Verdier-chouchane. can offset a portion of the cost of Entrepreneurs can provide cheaper, safer, and more timely products and services to the market and encourage FDI (Schwab, 2015). benefit increase commerce and investment Infrastructure is essential for inclusive and sustainable economic growth (National Planning Authority, 2015). The length of

roads per thousand inhabitants has a positive impact on economic expansion. from urban development and economic expansion, the function of road transport infrastructure in a nation's economic growth, according to Datta (2012), is that road quality improves production efficiency. Due to improvements in the quality and width of existing highways linking India's four major cities, road length per thousand inhabitants has increased. Increased access and enhanced road quality. aids in reducing production costs.

Muvawala et al. (2019) investigated the influence of Uganda's road transport infrastructure, growth in the economy, and traffic volumes. It demonstrates that investments in road transport infrastructure have a significant impact on the economy both in the short and long term. Long-term investments in transportation infrastructure A one percent increase contributes to long-term economic growth of 0.062 percent. In contrast, government expenditures increased by 0.09 percent, but the gross domestic product (GDP) increased. Over a two-year period, it will increase by 7.5%, but in the immediate term it will have a negative impact as the lost budget is enormous. Large investments in urban transport infrastructure networks, such as highways, expressways, and associated roads, particularly in urban and municipal areas, contribute to economic growth, which represents significant economic benefits.

Pradhan et al. (2013) examined the effect of transport infrastructure on India's economic development. Examining the impact of road and rail transport infrastructure, he concluded that expanding both road and rail transport infrastructure along with the creation of initial capital would result in substantial economic growth. The relationship between road transport infrastructure and economic development is bidirectional. Therefore, road transport is a driver of economic growth. For multiple purposes. First, road transport is an integral component of the production process. Therefore, an increase in road transport will contribute to economic expansion. and increased both the quantity and quality of road transport. This permits the government to collect toll duties, which increases government revenue. can contribute to an increase in the nation's gross capital with a higher gross domestic capital formation, economic

investment and expansion in the trade sector, particularly the manufacturing sector, will increase. Road transport will play a crucial role in generating jobs and increasing the country's per capita income. Maintaining appropriate transport policies is essential for promoting transport infrastructure and, by extension, sustainable economic growth.

2.2 Economic Impact Analysis

2.2.1 Input-Output Table

The table of production factors and outputs is a system of accounting that gathers data on the relationship between production and production utilization. Leontief devised and created it in 1986 by dividing the production system into industries or sectors. Productivity because it establishes a link between various economic sectors. Consequently, the schedule of production factors and output has been utilized. (Input-output Study) To comprehensively examine the economic impact and production structure, Tui and Adachi (2 0 2 1) utilized the production factors and outputs table. Evaluate the effects of export policy modifications. By analyzing the policy of Indonesia to prohibit the export of unprocessed mining commodities. According to the 2 0 1 0 Indonesia Table of Production Factors, 1 8 5 industrial sectors and 2 6 mining-related sectors exist in Indonesia. Furthermore, thirteen industries are involved in mining. Inputs and outputs matrix Input-Output Analysis is a valuable and significant instrument for analyzing the effects of changes in export policies, particularly the implementation of a ban on raw mining commodities. Assessment of inputs and outputs table model (Input-Output Analysis) permits examination of the current economic performance of each intermediate sector and the inter-sector relationships. Additionally, it can determine if the embargo policy has the potential to enhance the product's value for its intended purpose.

(Anas, Tamin, & Wibowo, 2015) evaluated the broader economic advantages of new Cipularang Toll Road infrastructure investment to the toll-connected Bandung region. Specifically, the indirect advantages received by the manufacturing sector (major sector) as a result of the decrease in freight costs. from the table of production and output factors regional input-output analysis is the foundation for macroeconomic planning and analysis, particularly in developing nations. Concerning

the production sector, analysis of impacts and connections between sectors and economic projections (GDP) by determining the coefficient of production factors and analyzing the backward linkage multiplier and the forward linkage multiplier. (Forward linkage multiplier) According to studies, each road infrastructure investment in the manufacturing sector reduces the cost of transporting products. (Cost of distribution) positively affects the manufacturing industry. macro economy Reduces transport costs associated with moving products between cities or regions, thereby increasing regional economic efficiency; industrial output multipliers increase total output value. If costs are reduced by 10%, the gross domestic product (GDP) will rise to 76,975 million baht. Whether investments in the restoration and construction of transport infrastructure are effective or not, and whether public funds would be better spent on other projects, is the subject of debate. The government invests public funds so that they have the greatest possible impact. There must be a method for evaluating the economic benefits of transportation initiatives. Obviously, this is necessary. To assure that these projects are deserving of economic development funding.

Using an inputs-outputs table, Jian and Michael (2010) determined the economic impact of investments in Australia's road, rail, water, and air transport infrastructure. (Input-output Study) 2007-2008, all thirty sectors for analyzing the economic influence of various transportation investments. There are two methods to analyze impact: price analysis and impact analysis. (Change in the value added or unit price of a specific industry's output) and production projections. (Change in the final demand of a specific industry) as a result of prospective sources of economic change. The importance of new transportation investments effects the transportation costs of businesses and the output price levels of various industries. Existing industries expand as a result of alterations in consumer demand.

The findings support the notion that infrastructure investment should be made due to its impact on economic growth. According to the price analysis, the implementation of new transportation projects is believed to reduce transportation costs for businesses and also impacts the prices of various sectors. The concentration of

transport factors influencing the supply of products or services will determine these price changes. For instance, industries with more transport-intensive inputs will have a greater positive effect than those with fewer transport-intensive inputs. along with economic impact analysis The decline in corporate expenses Changing Business Transport Service Requirements Although the impact of early demand remains the same, it is estimated that the new transportation investment will generate an additional $1 million in final demand for various transportation services. However, the industry-specific economic impacts of distinct modes of transportation vary. Investments in transport infrastructure initiatives that are well-planned can stimulate a wider range of economic activities. Investments in new transportation will have the greatest impact on service sector output. Specifically, the overall output of insurance. The sectors of Finance and Business Services and trade services will expand significantly. These findings are essential for policymakers to gain a deeper comprehension of the competitive environment of industries affected by transport infrastructure investment.

(Dwiatmoko, Hidayat, Supriyatno, Mudjanarko, & Ramli, 2020) explored the role of rail transport and four other transport sectors in the Indonesian economy from 2000 to 2010 using an input-output approach across 161 sectors. The policy outlines the function of the rail transport sector in comparison to other sectors. It analyzes the contribution of each transport sector to the overall output of the transport sector, as well as its interdependencies and results. Multiply each sector of transportation by its productivity, income, and workforce. The study indicates that vehicle transport holds the top position (38.19%) and increased its share to 52.12% in 2010. Due to the convenience of low-cost air transport businesses, air travel began to expand. (Low-cost airlines) make air travel an attractive option for the general public. Despite ranking lowest with a contribution of 1.15 percent, the participation of railways is extremely low due to Indonesia's inadequate railway network. and multiplier study It is a measurement of the response or effect of the economic stimulus, including the multipliers of output, income, and employment. Output multiplier the railway industry has a demand of up to 1 billion rupiah. Compared to other modes of transport, rail transit has the greatest impact

on the sector. Developing the railway sector by increasing its carrying capacity has the potential to increase final demand. Next, the revenue multiplier for the railway sector is 1.240. This indicates that for every 1.00 IDR increase in income from employment in rail transport, 1.240 IDR is added to the national income. Compared to other modes of transportation, the model deriving from the transport sector's employment multiplier calculation is superior. If train demand increases by 1 billion rupiah, the supply will be affected. About 9.556 billion individuals have employment opportunities across all sectors. If there is no relationship between each sector, employment opportunities will increase to 7.254 billion people, indicating the capacity to evaluate the sector's economic impact, productivity, income, and employment.

It also demonstrates the correlation between infrastructure and economic expansion in the same direction. Additionally, the maritime industry plays a significant role in the economy. From the table of production and output factors (Input-Output Analysis) and analyzing the backward linkage multiplier and forward linkage multiplier from the production model alongside the forward and backward link results. The port sector's impact has been determined by calculating the effects of price fluctuations and employment. The port sector's overall forward correlation was 0.97, while that of the overall economy was 0.48, indicating that the port sector did not rely on other sectors for production. As a result of its high degree of forward linkage, the port sector is heavily dependent on other industries. Chang et al. (2014) determined that a single unit scarcity in the port sector would result in a 17% loss to the entire economy.

Premsrirut (2010). Economic Structure of Ubon Ratchathani Province, Thailand. And analyzing the readiness of production and service activities that can stimulate economic development in the province of Ubon Ratchathani. The economic structure of Ubon Ratchathani Province was determined by preparing tables of inputs and outputs for 64 activities and using both primary data obtained from field surveys and secondary data received from various departments within the province, such as mass product data total province household consumption, investment and expenditures of government agencies, etc. Agriculture, industrial fabrics, and the service sector are

its three primary categories. Ubon Ratchathani Province's total output value in 2007 was 107,522 million baht, comprising 37.9 and 62.1 percent of the province's total output value. The proportions of each sector's output vary. When agriculture utilizes basic materials, 30 percent of the total value of agricultural output is accounted for. In addition, 70 percent of the total value of agricultural products was comprised of added value. While the industrial sector consumes a greater quantity of basic materials. Which represents 61.2 percent and 38.8 percent of the total value of industrial output with added value. In the service sector, the proportion of basic materials used was comparable to that of the agricultural sector, at 32.6 percent, and the value added accounted for 67.4 percent of the output value.

Product distribution can be divided into two types: the distribution of output as raw materials or factors of production, and the distribution of output as goods or services for final consumption, which will be used for private consumption (Consumption), government agencies (Government), investments (Investment), as well as import and export. In the agricultural sector, the distribution of output for use as production raw materials totals 4,683 billion baht. The final consumption of households was 2.076-billion-baht, government agencies were 8-million-baht, private investment was 7 million baht, and agricultural products were imported for raw materials and consumption in the provinces in the amount of 724 billion baht. whereas 7 820-baht worth of provincial products can be exported outside the province, industrial sector The distribution of output for use as raw materials for production amounted to 16,170 million baht, the distribution of output for use as private sector or household final consumption goods amounted to 8,793-million-baht, government agencies amounted to 116 million baht, and investment amounted to 1,456 million baht. In the amount of 17,918-million-baht, agricultural products were imported to be used as raw materials and consumed in the province, while provincial commodities could be exported outside the province in the amount of 13,037 million baht. 31.906 billion baht for the distribution of goods for ultimate household consumption, 17.731 billion for government agencies, and 5.610 billion for private investment. The province's production and service activities that are

readily available at a high level are those that meet all eight conditions, namely cassava cultivation. There are three production and service activities that are readily available at a moderate level, as follows: Agricultural products activities Agriculture and the manufacture of cement and concrete. As for low-readiness activities, there are numerous options, including chili sowing. Mango cultivation, precipitation, and rubber cultivation Flour Mills and Rice Mills.

Moreover, tables of inputs and outputs can be analyzed in additional methods. For instance, the Good Governance Institute for Social Development and the Environment (2010) has used the table of production factors and outputs to investigate methods for assessing developed and developing countries' shared responsibility for GHG emissions from industry. This study aims to assess the amount of greenhouse gases produced by Thailand's main industries and to develop a methodology for doing so. A system for analyzing and evaluating shared responsibility (Methodology). between developed and developing nations in terms of industrial greenhouse gas emissions from domestic production. Utilizing the table of production factors and output to evaluate the endeavor. Calculate the size of responsibility in terms of liability according to consumption versus liability according to the quantity of emissions at the point of production, and compare the results. Because this instrument can simultaneously calculate multiple industries. According to the information's resolution, there are 2 6 levels of branches.

The analysis of inputs and outputs (Input-Output Table) demonstrates that economic data can reveal the relationship between sectors. Both the value of economic activities and the relationship between different sectors of the economy are interconnected and can be connected in a variety of ways. The movement of transactional value within an enterprise system.

2.2.2 Satellite Data and Expanding the Economy Analysis

The application of satellite images, particularly at night, has proliferated over the past two decades. Numerous studies have been conducted on the socioeconomic intensity of light captured by remote sensing. Satellite image data are

used as proxies for various socioeconomic indicators. While a number of studies have discovered a strong correlation between nocturnal light intensity and gross domestic product (Pérez-Sindn, Xaqun S., Tzu-Hsin Karen Chen, and Alexander V. Prishchepov., 2021), others have not. 2013–2019) discovered that the majority of them are variables that measure the magnitude of economic activities, such as gross product or GDP, which is consistent with the findings of Shi et al. (2014), who also discovered a correlation in the same direction. X. Chen and W.D. Nordhaus (2011) on the applicability of illumination as a proxy for global gross domestic product (GDP) based on a comparison between GDP reported by national statistical accounts and illumination. bright twilight the results of an analysis of bright nighttime lighting indicate economic expansion. including the United States, It is a significant source of electronic transaction information and administrative datasets. Regarding the limitations of analytical applicability for middle- and low-income countries, the examined GDP data must increase their transparency and dependability. In addition, research has contrasted the estimation accuracy of DMSP/OLS and SNNP/VIIRS satellite illumination data with statistical economic variables such as those presented by Nordhaus and Chen (2015). The impact of the two satellites' nocturnal lights (NTL) on the population and grid cell product (GCP) of the districts. residing in Africa Using data from the year 2010 (2010) and dividing the estimate by the population of each area, namely the area with a population of less than 100 people, 1,000 people, 10,000 people, 100,000 people, and an unlimited population according to the number of people, the following estimate was calculated: Both satellites were statistically substantially positively correlated with both variables in the region, as indicated by the estimation results. Highly populous but in this region Only SNNP/VIIRS satellites discovered a statistical correlation in populations under 100. Can the Night Light (NTL) be a genuine representation of national economic activity? This is particularly true in the local and rural communities of low- and middle-income nations. Despite the limited ability to measure economic activity in high-density regions, the NTL is a decent representation of economic activity in rural-regional areas, with the VIIRS satellites' available datasets being the most appropriate for forecasting.

Forecasts of the Gross Domestic Product (GDP) and of rural municipalities NTL should not be undervalued to the extent that census and socioeconomic data are. In addition, this result demonstrates the potential of NTL as a method for measuring long-term socioeconomic change patterns. This is incredibly helpful for comprehending the pre- and post-effects of various interventions. (Infrastructure, policy, etc.)

Table 6 Summary of Research on Transport Infrastructure Development

Author	Objective	Data analysis	Results
Pradhan, R.P., & Bagchi T. P. (2013).	Effect of transportation infrastructure on economic growth in India: The VECM approach.	Vector Error Correction Model (VECM)	expanding transportation infrastructure (Both Road and Rail) along with the creation of capital leads to economic growth.
Muvawala, J., Sebukeera, H., & Ssebulime, K. (2021).	Socio-economic impacts of transport infrastructure investment in Uganda: Insight from frontloading expenditure on Uganda's urban roads and highways	Auto Regressive Distributed Lag (ARDL)	Investments in road transport infrastructure have a significant impact both in the short and long term on economic growth.
Ramanathan, R., & Parikh, J. K. (1999).	Transport sector in India: an analysis in the context of sustainable development.	Auto Regressive Distributed Lag (ARDL)	Sustainable transportation structure development directly into manufacturing faster. It connects other transit. reduce time Lower travel costs
Ondiege, P., Moyo, J. M., & Verdier-Chouchane, A. (2013).	Developing Africa's infrastructure for enhanced competitiveness.	Competitiveness	Infrastructure gaps raise corporate costs. Sustainable transport infrastructure boosts GDP per capita.

Table 6 Summary of Research on Transport Infrastructure Development (Cont.)

Author	Objective	Data analysis	Results
Datta, S. (2012).	The impact of improved highways on Indian firms.	Competitiveness on the effect of policy variables	Road quality increases production efficiency. can be connected to major cities, increasing accessibility helps reduce production costs

Source: Determined by researcher.

Table 7 Summary of Economic Impact Analysis Research

Author	Objective	Data analysis			Results
		I-O	SAM	CGE	
		Table			
Tui, R. N. S., & Adachi, T. (2021).	An input-output approach in analyzing Indonesia's mineral export policy.	✓			Potential export embargo policies that can increase the value of goods
Ridwan, A., Ofyar Z, T., & Sony S, W. (2015).	Applying input-output model to estimate the broader economic benefits of Cipularang Tollroad Investment to Bandung District.	✓			Road infrastructure investment reduces freight costs. while positively affecting the manufacturing sector and the macroeconomic level
Jian, W., & Michael B, C. (2010).	IO Based Impact Analysis: A Method for Estimating the Economic Impacts by Different Transport Infrastructure Investments in Australia.	✓			Should invest in infrastructure affect economic growth Reduce transportation costs for businesses and sector prices.

Table 7 Summary of Economic Impact Analysis Research (Cont.)

Author	Objective	Data analysis			Results
		I-O Table	SAM	CGE	
Dwiatmoko, H., Hidayat, A.K., Supriyatno, D., Mudjanarko, S.W., & Ramli, M.I. (2020).	The influence of railway development on the indonesian national economy: an input-output approach.	✓			Rail transport and four other transport sectors affect the economy, output, income and employment.
Chang, Y. T., Shin, S. H., & Lee, P. T. W. (2014).	Economic impact of port sectors on South African economy: An input–output analysis.	✓			The port sector is heavily used in other industries with high forward links. affecting the shortage of goods
Premsrirut, T. (2010).	A Study of the Economic Structure of U-bonrajathanee Province: An I/O Table Approach.	✓			The production activities that can create the growth for the economy of Ubon Ratchathani the most are cassava farming

Source: Determined by researcher.

Table 8 summarizes research on analyzing satellite data and economic growth.

Author	Objective	Data analysis	Results
Pérez-Sindín, X. S., Chen, T. H. K., & Prishchepov, A. V. (2021).	Are night-time lights a good proxy of economic activity in rural areas in middle and low-income countries? Examining the empirical evidence from Colombia.	satellite photo night-time lights	nighttime lights show economic growth.
Chen, X., & Nordhaus, W. D. (2011).	Using luminosity data as a proxy for economic statistics.	satellite photo night-time lights	nighttime lights show economic growth. even the United States
Nordhaus, W., & Chen, X. (2015).	A sharper image? Estimates of the precision of nighttime lights as a proxy for economic statistics.	satellite photo night-time lights	NTL It is a good representation of economic activity in rural areas.

Source: Determined by researcher.

According to the researcher's literature review and related research, Transport infrastructure development policies are crucial to the nation's growth. affecting both direct and indirect economic growth Specifically the growth of land transport and the expansion of the road network. As road transport is the country's primary mode of transportation and a gateway between other modes of transport, it is essential to the nation's economy. in addition to rail transport, water transport, and air transport in addition, the expansion of the road network improves connectivity between the city and the surrounding region. Specifically, intercity highways connecting cities and regions. Various construction initiatives are considered concurrently when deciding which to build. What are the costs and benefits or returns to the nation? An economic impact analysis is necessary. From the literature review, analyze the production factors and outputs using the table. (Input-Output Table) through an analysis of the relationship between sectors and economic forecasts. Finding the factor coefficient and analyzing the backward linkage multiplier is sufficient to determine the forward linkage multiplier for the production sector's impact. to reach a conclusion regarding the direction of the evident impact of government expenditures resulting from the investment in the intercity highway project. Bang Pa-in - Nakhon Ratchasima Line Additionally, satellite images of night lights were used to examine the economic development of the project area. To comprehend the regional expansion.

Chapter 3
Research Methodology

Applying secondary data, A Study to Analyze the Economic Impact of the Intercity Motorway Project Bang Pa-in - Nakhon Ratchasima is a quantitative investigation (Quantitative Method). The researcher then took the subsequent actions.

1. Determination of the population and sample selection

2. Creation of research instruments

3. Collecting data

4. Data preparation and analysis

1. Determination of the population and sample selection

Population

This study identified the population residing or operating businesses in the vicinity of the proposed intercity motorway. Bang Pa-in - Nakhon Ratchasima consists of the provinces of Phra Nakhon Si Ayutthaya Saraburi and Nakhon Ratchasima.

Sample selection

This study selected the sample group based on the population living or operating a business in the project location. by choosing a particular sample group Those who are involved in the intercity highway initiative are qualified. Bang Pa-in - Nakhon Ratchasima These 10 individuals are considered critical informants because they are all representatives with knowledge and skills directly related to the project and are able to provide valuable insights. Capable of providing an overview of the project region in the 3 provinces. Three government representatives, two private sector representatives, and 5 household representatives comprised the study's sample groups.

The data used in this study consisted of: This study selected the sample group based on the population living or operating a business in the project location. by choosing a particular sample group Those who are involved in the intercity highway initiative are qualified. Bang Pa-in - Nakhon Ratchasima These 1 0 individuals are considered critical informants because they are all representatives with knowledge and

skills directly related to the project and are able to provide valuable insights. Capable of providing an overview of the project region in the 3 provinces. Three government representatives, two private sector representatives, and 5 household representatives comprised the study's sample groups.

1. primary data obtained through in-depth interviews using a questionnaire regarding the impact of the intercity special highway project and secondary data. Bang Pa-in - Nakhon Ratchasima It is comprised of Intercity Motorway initiative participants. Bang Pa-in - Nakhon Ratchasima, which is a knowledgeable individual Three representatives from government agencies, two representatives from private agencies, and five representatives from households were considered primary informants for the second objective.

Data Collection Method

1. Establish communication and coordination with government agencies Document sector, domestic sector, and number sector

2. Develop a series of interview queries. Based on an examination of pertinent project impact assessment documents

3. Go to the interview location.

2. Secondary Data to Address Objectives 1 and 2.

2.1) Data extracted from a compilation of articles Includes statistical data from agencies such as the Statistical Office and the Department of Highways, as well as data collection from agencies in Germany, Sweden, Belgium, Austria, and Japan in charge of logistics infrastructure development plans. as well as in Thailand

2.2) Database from the table of production factors and output (Input-Output Table), Thailand, 2015, size 180 production activities and budget information for construction of special highway projects between the cities of Bang Pa-in and Nakhon Ratchasima, total of 40 construction contracts by the Department of Highways.

2.3) Before and after the undertaking, collect satellite data and geoinformatics for the purpose of considering economic growth. Economic changes resulting from the construction of the Bang Pa-in - Nakhon Ratchasima line intercity

motorway project, including night time light data detected by satellites (Night Time Light: NTL) in 2015-2022 with socioeconomic variables: Gross Provincial Product (GPP) for three provinces in the project area, as well as the correlation between socio-economic variables and satellite and geospatial data. correlation analysis to estimate the data variables

2. Creation of research instruments

These instruments are used to analyze data in the research:

Objective evaluation 1. Collecting qualitative information regarding transport infrastructure development in Thailand, development, development guidelines, and future transport infrastructure development plans in Germany, Sweden, Belgium, Austria, and Japan. by gathering information from the strategic plan of responsible agencies and reviewing research pertaining to transport infrastructure development policies.

Objective evaluation 2. Use quantitative analysis. (Quantitative Method) consists of three sections: Interview in depth (Interview in Depth) Table of factors of production and output (Input-Output Table). B.E. Bang Pa-in - Nakhon Ratchasima Line is entered into the table. 3. Satellite imagery and geospatial data, along with the following procedures:

1. In-depth interview: a semi-structured interview with predetermined, open-ended interview questions that allow the interviewee to convey his or her opinions. fully Without guiding the response to obtain the most factual data. In order to accomplish the objectives of the study, which consisted of a sample group and the following interview form components, the following information was compiled:

The first batch of questionnaires for government agency representatives consists of nine questions organized as follows:

Part 1: General biographical information on interviewees

Part 2: Information Regarding the Bang Pa-in to Nakhon Ratchasima Line Intercity Motorway Project

Part 3 : Project Management Part 4 : Construction Planning for Interstate Highway Construction Bang Pa-in - Nakhon Ratchasima Line

Part 5: Situation of Users of the Bang Pa-in-Nakhon Ratchasima Line Intercity Motorway Project

Part 6 : Social aspects, environment, economy, employment, trade, positive and negative social aspects before and after the undertaking.

Part 7: Guidelines for preventing and resolving project-related issues

Part 8: Guidelines for future project development

Part 9: Additional Comments and Suggestions

The second batch of questionnaires for private agency representatives the evaluation form contained the following six questions:

Part 1: General biographical information on interviewees

Part 2: Intercity Motorway Projects Experiences Bang Pa-in - Nakhon Ratchasima Line

Part 3: The Importance of the Bang Pa-in to Nakhon Ratchasima Motorway Project

Part 4 : Expectations for the Bang Pa-in to Nakhon Ratchasima Line Intercity Motorway Project

Part 5 : Effects of the Bang Pa-in-Nakhon Ratchasima Line of the Intercity Motorway Project Prior to and following the undertaking, there are both positive and negative aspects.

Part 6: Additional Comments and Suggestions

The third batch of household representative questionnaires the evaluation form contained the following six questions:

Part 1: General biographical information on interviewees

Part 2: Intercity Motorway Projects Experiences Bang Pa-in - Nakhon Ratchasima Line

Part 3: The Importance of the Bang Pa-in to Nakhon Ratchasima Motorway Project

Part 4 : Expectations for the Bang Pa-in to Nakhon Ratchasima Line Intercity Motorway Project

Part 5: Impact received from the Intercity Motorway Project Bang Pa-in - Nakhon Ratchasima Line Before and after the project has both positive and negative aspects.

Part 6: Additional Comments and Suggestions

2. Table of production and output factors (Input-Output Table) for the year 2015 in Thailand, to which the construction of intercity expressways was Bang Pa-in - Nakhon Ratchasima Enter in the table

Step 1: Collecting secondary data from various sources to bring the table of production factors and output up to date. And reflect the economic landscape of Thailand in 2022. This study will utilize secondary data from the following sources: 1) A table of production and output factors. (Input-Output Table) 2015, which is the most recent edition to be compiled and released. By the National Economic and Social Development Council's (NESDB) Office. 2) The income accounting summary for the year 2022 for Thailand 3) Financial statements of the project construction companies' legal entities for the year 2022 in the business data repository system of the Department of Business Development of the Ministry of Commerce 4) The Customs Department's export and import data at the product level for the year 2022 5) Production data and domestic sales volume by product for 2022 from the Office of Industrial Economics 7) Other data, including the National Statistical Office's labor force survey of the population (Labor Force Survey) and numerous tax information for the year 2022

Step 2: Accurately update the Table of Factors of Production and Output (I/O Table) for the year 2015 for Thailand. And reflect the economic structure of the year 2022 using the secondary data gathered previously. To update the table of Thailand's factors of production and output, for instance, use the table of Thailand's national income for 2022 to update information on economic value, value added, and final

demand. Use the household socio-economic survey data from 2022 as a database for household income and expenditures in Thailand, etc.

Step 3: incorporating the production sector, construction sector, and non-agricultural public service activity This division includes the construction and maintenance of highways, roads, bridges, wharves, airports, train stations, main water pipelines and sewage discharge lines, among other things. The department code 141 is inserted into the I/O Table, where the vertical data (Column) represents the production structure. And the use of intermediate inputs and primary inputs as well as horizontal data (Row) represents the structure of the distribution of output to intermediate consumption. (Intermediate demand) and ultimate consumption (ultimate demand) of the construction of intercity highways' production sector. Bang Pa-in - Nakhon Ratchasima

Step 4: Data processing and calculation/review (Calibration) I/O Table with updated production fields for intercity highway construction projects. Bang Pa-in - Nakhon Ratchasima. Due to the addition of more production sectors to the intercity highway construction project,

Step 5: is to prepare the balancing table (Balancing) using the RAS method. Inserting the Bang Pa-in - Nakhon Ratchasima line into the preceding I/O table will result in a vertical sum of the data. Both vertically (Column) and longitudinally (Row) are unequal. Therefore, the table must be balanced using the RAS method, a new technique for creating matrices. When a new sum data value is calculated and the new matrix retains the same element structure as the original matrix (Miller & Blair, 2009)

3.Satellite images and geospatial data This research utilized satellite imagery of night-time light data from the Visible Infrared Imaging Radiometer Suite (VIIRS), satellite data gathered by the Suomi National Polar-orbiting project. A new satellite, Partnership (SNPP)8, was launched into orbit. and has a nighttime light sensor After 2013, this dataset can be used to supplant DMSP/OLS. The SNPP/VIIRS night light data has a greater dot per area resolution (1 pixel). Equal to a surface area of 375 by 375 meters on earth) and the luminance level of each data point is equal to 256 levels. It

comprises monthly data from January 1, 2015 through December 31, 2022. The stages involved in writing commands to retrieve data from Google Earth Engine can be summarized as follows.

In the first step, a map file or shapefile is uploaded, followed by the creation of a variable containing the desired data, in the case of nocturnal illumination. will generate a command to access the data based on this instruction.

var viirsLights = ee.ImageCollection('NOAA/VIIRS/DNB/MONTHLY_V1/VCMSLCFG');

Step 2 : Specify the intended data region's coordinates. In the case of Thailand's nighttime illumination values, the information will be written in this order.

var roi = ee.Geometry.Polygon([[[97.3437, 20.2756], [105.6347, 20.2756],

[105.6347, 5.6129], [97.3437, 5.6129]]]);

Step 3 : is to specify the time period for retrieving night time illumination (NTL), which in this study begins on January 1, 2015 and ends on December 31, 2022, and to calculate. Monthly charge in accordance with this order.

var startDate = ee.Date('2015-01-01');

var endDate = ee.Date('2021-12-31');

var filteredCollection = viirsLights.filterBounds(roi).filterDate(startDate,

Step 4: Calculate the average night illumination index (NTL) and night illumination satellite images. This command displays each region in accordance with the uploaded map file and the desired time period.

var sortedCollection = filteredCollection.sort('system:time_start');

var oldestImage = ee.Image(sortedCollection.first());

var clippedImage = oldestImage.clip(roi);

var convertedImage = clippedImage.toFloat();

The last stage is to display the average data and satellite images of the nighttime Light value (NTL) and save the data in CSV and Geo-tiff format, with the resulting file being stored in the user's Google Drive.

// Print the chart

// Export the clipped image to Google Drive

```
Export.image.toDrive({

  image: convertedImage,

  description: 'nighttime_lights_image',

  folder: 'Nighttime_Lights',

  fileNamePrefix: 'oldest_nighttime_lights',

  scale: 1000, // Adjust scale as needed

  region: roi

});
```

When deciding the monthly average of the nighttime light index (NTL), the satellite images can be adjusted to the annual average. Select the specific data to be analyzed and determine the relationship between the economic and social variables and the satellite data by analyzing the satellite data alongside economic and social data or by arranging the data in the form of a boundary map using the Quantum GIS program. using correlation and geospatial to estimate the data variables.

3.Collecting data

Collection of data for use in this study Complement primary data (Primary Data) and secondary data (Secondary Data) with data from sources that meet the following research objectives:

Primary Data: Through in-depth interviews, data was collected. We utilized a semi-structured interview. There were three categories of informants: three representatives of government agencies, two representatives of the private sector, and five representatives of households.

Secondary Data: Records Compiling a strategy for the development of logistics infrastructure in foreign countries by collecting government data for logistics development constitutes the collection of secondary data. rags in this research, Germany, Sweden, Belgium, Austria, and Japan were utilized as countries. To examine and contrast the growth of transport infrastructure in Thailand and abroad. Germany, Sweden, Belgium, Austria, and Japan

The Office of the National Economic and Social Development Council (NESDB) has revised the inputs and outputs table (Input-Output Table) for the year 2015, 180 Production operations Information on the budget for the construction of intercity highways. Bang Pa-in - Nakhon Ratchasima, a total of 40 contracts, Gross Domestic Product (GDP) and Gross Provincial Product (GPP), which includes essential sub-data, specifically household consumption value. The value of government investment expenditure Inventory Value Export-Import Value is determined by collecting data from a variety of agencies, such as the Office of the National Economic and Social Development Board the National Statistical Office and the Board of Investment.

Satellite-detected nighttime light data (Night Time Light: NTL) Length data with socioeconomic variables, specifically Gross provincial products (GPP) from 2013 and 2021.

4.Data preparation and analysis

This study's data analysis was divided in accordance with its objectives as follows:

1. An examination based on objective number 1. by collecting qualitative data on the development of transport infrastructure in Thailand, development, development guidelines, and future transport infrastructure development plans in Germany, Sweden, Belgium, Austria, and Japan; 2. by analyzing the collected data; and 3. by drawing conclusions. by gathering information from the strategic plan of responsible agencies and reviewing research pertaining to transport infrastructure development policies.

2. Analysis based on an objective number 2. Utilize quantitative analysis. (Quantitative Method) separated into three sections: Utilizing tables of production factors and output. (Input-Output Table) 2015 Budget for the Intercity Motorway Project Bang Pa-in - Nakhon Ratchasima Line, which is divided into two parts, the first of which is a study on the economic linkages of the intercity motorway project; Bang Pa-in - Nakhon Ratchasima Line on various economic sectors of Thailand, and the second of which is a study on the economic

multiplier of the intercity highway project. Bang Pa-in - Nakhon Ratchasima Line On the outcome (Output) based on the work schedule's information. Thailand's Production Factors (Input-Output Table) Year 2015, utilizing economic sector classification in the form of 180 production divisions in this study Considering the production sector, data from the Office of the National Economic and Social Development Council (NESDB) indicate: Development of non-agricultural public services This division includes the construction and maintenance of highways, roads, bridges, wharves, airports, train stations, main water pipelines and sewage discharge lines, among other things. Branch code 141 represents intercity highway construction initiatives. Bang Pa-in - Nakhon Ratchasima Line Because it is the most closely affiliated manufacturing sector out of the 180 available.

1) Economic Interconnectedness

1.1 Structural Analysis of Factors of Production The vertical (column) data of the factors of production table can be used to examine the structure of factor utilization. To calculate the coefficient of the direct factors of production (aij), which provides an indication of the production structure of the production sector of the j economic sector, that in the effect of the j economic sector, intermediate factors of production derived from domestic production use inputs. How much value is added to economic sector i by intermediates that originate from imports and use primary production factors?

1.2 Analysis of Product Distribution Structure

The output distribution structure can be analyzed by taking the data horizontally (Row) from the economic sector i of the table of production and output factors. Calculate, in the table of commodities and services transactions (Transaction Table), the ratio between the output of each economic sector (Xij) and the total output (Xi). It is evident that the output of each economic sector to which consumer groups have these results been disseminated? (Uthis Pongjiravattana and Patcharee Larabhat, 2017)

1.3 Economic Integration

There are two distinct categories of direct economic ties: Direct Backward Linkage, which describes the structure of the use of factors of production. in what proportion one economic sector is dependent on factors of production from other economic sectors. The posterior of the j economic sector is calculated as the ratio of the entire sum of all intermediate factors of production consumed by the j economic sector to its total outputs.

$$U_j = \frac{\Sigma_j^n X_{ij}}{X_j} \text{ หรือ } U_j = \Sigma_i^n a_{jj}$$

The direct backward linkage equals the sum of the direct input coefficients (aij). The direct forward linkage in the field of project construction informs the distribution structure of how the output is distributed to various economic branches for use as a factor in production. The direct correlation of economic sector i is calculated by comparing the total intermediate demands of economic sector i's output to the total outputs of all economic sectors.

$$U_j = \frac{\Sigma_j^n X_{ij}}{X_j}$$

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X_j = productivity of sector j

X_i = productivity of sector i

$\Sigma_j X_{ij}$ = The sum of direct intermediate inputs used by sector of production j

$\Sigma_i X_{ij}$ = The sum of the outputs sector i at other production sector used as a factor of production

n = The total number of economic branches of the economy

which the greater the values calculated for Uj and Ui, In contrast, if the calculated Uj and Ui values are lower, it indicates that the economy is less interdependent with other economic sectors.

Global Index of Economic Connectivity

Global Economic Linkage Index (Direct and Indirect Linkage Effect), which measures the extent of economic interdependence. The direct and indirect effects of changes in the final demand path of economic sectors on the production levels of other economic sectors. As both a vendor and a buyer of factors of production, utilizing Calculated from the matrix of direct and indirect factor coefficients (matrix $(I - A)^{-1}$). It is separated into two sections:

The Backward Linkages Index is an indicator of the impact of economic sector development on the overall economy. A factor of production resulting from the demand for results in other domains of production is what causes other production sectors to exist. The production expansion (Sakarin Wangkahat, 2009).

$$a_j = \frac{\Sigma_i b_{ij}}{\frac{1}{n}\Sigma_i \Sigma_j b_{ij}} \quad (I = j = 1,2,.....,n)$$

Forward Linkages Index is an index that highlights the flow of output from one sector to another.

$$\beta_i = \frac{\Sigma_i b_{ij}}{\frac{1}{n}\Sigma_i \Sigma_j b_{ij}} \quad (I = j = 1,2,.....,n)$$

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A = Intermediate factors coefficient matrix

I = identity matrix

a_i = sum of backward link index

β_i = sum of direct intermediate inputs used by branch of production j

$\Sigma_i b_j$ = sum of the horizontal sides of the matrix

$\Sigma_i b_{ij}$ = sum of the horizontal sides of the inverse matrix

$\Sigma_i b_{ij}$ = sum of the horizontal sides of the inverse matrix

$\Sigma_i b_{ij}$ = sum of the vertical sides of the inverse matrix

n = total number of production branches in the inverse matrix

However, the average value of the global connectivity index is 1 . Therefore, if an economic or manufacturing sector's aggregate connectivity index is greater than 1, it indicates that the sector is highly connected. The aggregate correlation was greater than the average correlation across all production sectors

  2. Multiplier Analysis

    Regarding the economic multiplier analysis Before it can be calculated, the direct and indirect coefficients of production factors (Direct and Indirect Coefficient) must be known. Factor coefficient of effect Intermediate in the nation (Matrix A) as indicated below:

From X $= AX+F$

   $(I - A)^{-1}X$ $= F$

   X $= (I - A)^{-1}F$

Assign to

Matrix $(I - A)^{-1}$

Instead of Matrix B ซึ่ง $B_{ij} = \begin{bmatrix} b_{11} & b_{12} \dots & b_{1n} \\ b_{21} & b_{22} \dots & b_{2n} \\ \vdots & \vdots & \vdots \\ b_{n1} & b_{n2} \dots & b_{mn} \end{bmatrix}$

X instead of q The equation can be written as follows:

$$q = B\,F$$

    The matrix $(I - A)^{-1}$, or with matrix B, is known as the direct and indirect factor coefficient, or Leontief's Domestic Matrix, which explains that a 1% change in the final demand of economic sector j will cause a corresponding 1% change in production in direct and indirect economic sectors according to the coefficient of direct and indirect factors of production in bij percent (Sanglaoid et al., 2014: 122).

    2. Analysis satellite data and geo-informatics will be analyzed as a result of the construction of the intercity highway project. Finding the relationship

between the Bang Pa-in - Nakhon Ratchasima line, including night light data detected by satellites (Night Time Light: NTL) and socio-economic variables, namely Gross provincial products (GPP), for the years 2013 and 2021. Create a code to retrieve data from Google Earth Engine and analyze it with economic and social data or organize the data in the form of a boundary map using the Quantum GIS program to select data for spatial statistics. Only the area that requires analysis Consider the economic growth in the project area and determine the relationship between socio-economic variables and satellite and geo-information technology data. correlation analysis to estimate the data variables.

3. Analysis of data from in-depth interviews After the interview, the researcher categorized the information into question categories and performed multiple readings to comprehend the comments and emotions of informants regarding the Bang Pa-in - Nakhon Ratchasima intercity motorway project. The researcher then organizes the sub-issues into a single narrative. So, is a synopsis of the key elements Write an explanatory essay to ensure the interview's continuity and coherence. Write a summary that explains the relationship between the information obtained from relevant literature and the Bang Pa-in - Nakhon Ratchasima Intercity Motorway Project impact analysis.

Chapter 4
Results

Investigation of the Bang Pa-In-Nakhon Ratchasima Intercity Motorway Project's economic impact. The investigation was conducted using a variety of processes and procedures. conform with the predetermined objectives of the study The investigation was divided into the following two sections.

Part 1:Comparative Study and Analysis of Transport Infrastructure Development in Thailand and Abroad Germany, Sweden, Belgium, Austria, and Japan It provides an overview of the transportation system. development policy principles the outcomes of the development plan's implementation Describe problems and success-supporting factors. As policy planning suggestions for the development of transportation infrastructure.

Part 2 Economic Impact Analysis of the Intercity Motorway Project Bang Pa-in - Nakhon Ratchasima Line examines the production structure and production linkage. Planning spatial analysis Impact assessment conducted by project participants to evaluate the project's macro and micro impacts.

4.1 Examine and compare the evolution of transportation infrastructure in Thailand and abroad. Germany, Sweden, Belgium, Austria, and Japan.

This study investigates the evolution of transportation infrastructure policies in the world's five foremost logistics nations. development policy principles the outcomes of the development plan's implementation Identify problems and success-contributing factors. Which group of the top five countries in the world has the maximum logistics efficiency? To attain the objective of Thailand's transport development plan and rank among the top 25 countries in terms of logistics efficacy. In order to develop and improve the country's logistics standards, it is necessary to examine the policies and development plans of the five most successful countries in logistics, in addition to preparing national standards. country in a continuous and concrete manner:

Germany

Germany is an exporting nation where efficient, eco-friendly logistics and a modern infrastructure are crucial for international competitive success. As a transportation and logistics hub, Germany is ranked by the World Bank as not only Europe's but also the world's foremost transport nation. This is how the German maritime sector is perceived.

Overview of Transport Infrastructure

Individuals in Germany travel frequently for both personal and professional purposes. Germany is an exporting nation. It is a country with advanced technology and a transit nation. Therefore, dependent on efficient passenger and cargo transportation. Therefore, adaptability is a crucial factor. In the medium and long term, they will be unable to capitalize on the opportunities presented by progress and globalization. Except if a high-capacity transportation system is constructed to serve the nation's population and industry. Modern society requires modern mobility for economic development, employment, and national prosperity. Germany has one of the most advanced transportation networks in the globe. Existing transportation infrastructure must be kept in excellent condition. Even though transportation demand will continue to rise in the future. And it must be expanded and optimized on a conveyance network that is continually expanding.

The German Federal Ministry of Transport has developed a transport forecast for 2030. It is anticipated that population passenger travel distance will increase. (Number of passengers multiplied by average distance traveled) by 12 percent compared to 2010, which averaged an annual growth rate of 0.6 percent. In addition, freight and transportation will increase as freight traffic increases. The increase in movement (the mass of products transported multiplied by the distance traveled) led to a 38 percent expansion of Germany's transport infrastructure. A significant increase in international transport volumes was the primary driver. It is probable that all modes of transportation will experience rapid expansion. particularly the railway anticipated growth rate of 42.9 percent indicates that future investments in new construction will be higher than in the past.

Guidelines for the Growth of Transport Infrastructure

The German Federal Ministry of Transport and Digital Infrastructure developed the German Government Transport Infrastructure Plan. It is supported by consultants whose project proposals have been submitted to and approved by the federal Cabinet. Provides a framework for federal transportation infrastructure investment. The proposal was subsequently approved by the government cabinet. It is illegal in nature and is not a fundraising scheme. Valid for the development plan from 2016 to 2030, this Federal Transportation Infrastructure Plan consists of investments in existing required maintenance projects and investments in replacement infrastructure. The federal government is responsible for the improvement and reconstruction of a network of roads, railroads, and waterways. In the instance of renovation and new building The Federal Transport Infrastructure Plan for 2 0 3 0 (FTIP) concentrates on evaluating projects that have a significant impact over a wide area and produce significant capacity-enhancing or quality-improving effects. Consider whether the construction endeavor is beneficial and essential for the economy as a whole. Focus on project proposals that have the most impact on the economy as a whole. Federal Minister of Transport and Digital Infrastructure, 2021)

In order to develop an effective plan for transport infrastructure Initial objectives must be crystal clear. when developing the 2 0 3 0 Federal Transport Infrastructure Plan (FTIP) was developed in response to transportation and environmental programs and goals, as well as problem-solving strategies derived from goals where the federal transportation infrastructure plan can have a significant impact. Consider the development plan phases illustrated in Figure 7.
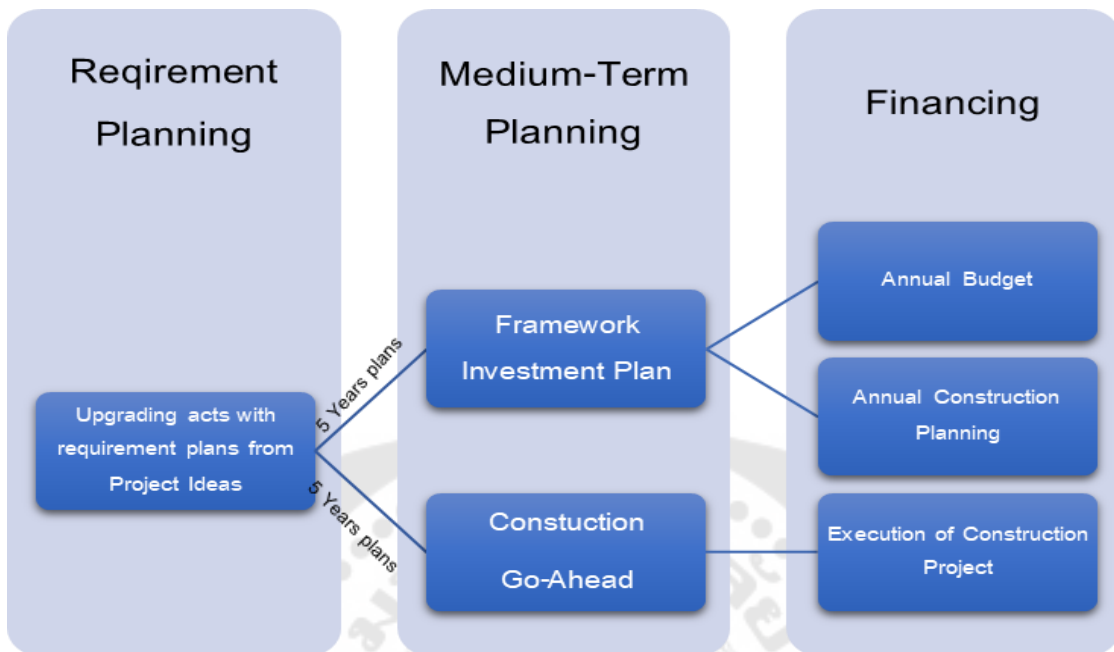
Figure 7 Show the connections between the fundamental elements of structural

transportation planning

Source: Determined by researcher

Transport infrastructure investments target pollution reduction measures. There are parking spots for large trucks on the freeway. a bike path on the road interchange and overpass, or transportation safety enhancements such as expanding two-lane federal highways to three lanes. In some instances, the central government, local authorities, or initiatives (such as immediate action projects for land traffic to and from ports, the Second National Noise Reduction Guidelines, or the ITS Action Plan) address this investment through a separate plan. These measures may be implemented independently of the FTIP and Demand Plan.

The FTIP 2030 primarily concentrates on transport policy objectives. It has been significantly impacted by the development of transportation infrastructure. Therefore, the agility of passenger and freight transport is dependent on a robust

infrastructure. It is a necessary condition for the efficient operation of all modes of transportation. The FTIP evaluation also considers aspects of transportation safety. Abatement of global warming environmental conservation However, the development of transportation infrastructure is not primarily concerned with conservation.

The outcomes of the development plan's implementation

In the four pilot initiatives of the first series (2005-2009), public-private partnerships were established. Public-private partnerships (PPPs) on the main road motorway to the suburbs and the state border concurrently with the expansion of the motorway and structural maintenance projects and projects to fill gaps in existing necessary project maintenance investments and replacement infrastructure investments. The federal government is responsible for the improvement and reconstruction of a network of roads, railroads, and waterways. In the instance of renovation and new building The Federal Transport Infrastructure Plan for 2030 (FTIP) concentrates on evaluating projects that have a significant impact over a wide area and produce significant capacity-enhancing or quality-improving effects. Consider whether the construction endeavor is beneficial and essential for the economy as a whole. Concentrate on project proposals that are vital to all extant economies, thereby accelerating and improving the construction of necessary roads. To decrease congestion and the economic damage induced by congestion. to adhere to the life cycle guidelines for construction, structural maintenance, operations, and proportional funding, and to be able to incorporate private capital via institutional investors and project bonds.

Plan's primary objective is to optimize passenger and cargo transportation services. and to enhance the competitiveness of numerous businesses by supporting the maintenance of extant network infrastructure in Germany, FTIP 2030 significantly contributes to these goals. Eliminating bottlenecks and reducing inaccessibility deficiencies, while giving structural maintenance precedence over new construction, would be advantageous. It prevents the deterioration of the extant structures of all three modes of transportation. Despite the fact that the new construction

plan must be revised. It has a reliable, efficient, and contemporary transportation network. It is crucial for both passenger and freight transportation. The road construction project will eradicate capacity bottlenecks along the roughly 2,000 kilometers (measured in both directions) of German highways. This will result in a reduction of more than 160 million hours of traffic congestion per year. This represents roughly 42 per cent of the annual time spent in congestion. that are likely to occur on highways The network's rail project seeks to eliminate capacity bottlenecks along its roughly 800 km length, allowing more passengers and freight to be transported by train. This will reduce potential train delays by about 13 percent and potential annual waiting times by about 15,200 hours per year. This will result in an annual reduction of 1.5 billion kilometers traveled by passenger vehicles and 724,000 HGV trips (with 519 million HGV kilometers traveled). The FTIP initiative has a predominantly positive economic impact on users. The reduction in freight and passenger transport operating and transport costs is the most significant impact. Gains in terms of the amount of time required to transport products. Increased dependability and reduced travel periods in commercial and non-commercial passenger transportation the economy of the United States will benefit by approximately 100 billion euros from initiatives involving all three modes of transport.

Problems and factors supporting infrastructure development strategies for transportation

With constitutional restrictions on public funding and borrowing. Therefore, investments in transportation infrastructure encounter competition from other government-responsible initiatives. The financial resources that have historically been insufficient to implement all the upgrades and new construction projects that are beneficial to transport policy and the economy as a whole while maintaining the network's structural integrity. There is also the potential for investment conflicts between transport modalities. Germany has received approximately 1,6 billion euros between 2014 and 2020, primarily from investments in railway and rail initiatives. Because of water, transportation development is reduced. To close the revenue deficit caused by the reduction of HGV tolls in January 2015 and to secure funding for transportation infrastructure. Consequently, the policy of collecting mandatory tolls from HGVs has

been significantly expanded. Since July 2015, tolls have been imposed on an additional 1,100 kilometers of federal highways. Since October 2015, vehicles with a maximum permitted weight between 7.5 and 12 tones are also subject to the toll. way too According to the collective bargain, it will go into effect in 2018 in order to finance the maintenance and upgrade of the highway network. ...and to provide adequate ongoing funding for transportation infrastructure and comprehensive planning. The upgrading and construction of new transportation infrastructure must utilize public funds responsibly and, in the public's, best interest. Therefore, careful planning is required to determine which transportation investments will provide the greatest public benefit. And action is of the paramount importance.

Sweden

Sweden is one of the European Union countries with a higher proportion of rail transport than many others. And it is nearly the primary mode of transport for the shipment of products. The vast majority of Sweden's domestic transportation system relies on land conveyance. Sweden imposes tariffs on travel and air travel. To promote the use of less polluting modes of transportation. for the productivity of the logistics industry Sweden is one of the best-transported nations in the world, scoring highly on all factors used by the World Bank to compute logistics efficiency indicators. Therefore, Sweden can develop more efficient logistics capabilities.

Overview of Transport Infrastructure

An overview of the grade of Sweden's transportation infrastructure is provided. According to the 2018 Global Competitiveness Report, Sweden's road transport infrastructure is highly efficient. In terms of transportation safety, Sweden outperforms all other European nations. The mortality rate has been below the EU average since 2010. And Sweden has developed a road safety policy known as "Vision Zero," which is a strategic approach to creating a safety system in which no one is at risk of death or severe injury while using road transportation. and utilize alternative fuels for both public transportation and passenger automobile groups However, the passenger vehicle group has a greater proportion of alternative fuel consumption, which is biodiesel, while the total consumption of alternative energy is high. Additionally,

electric cars are prevalent among the country's populace. Since 2 0 1 4 , the number of rechargeable electric vehicles has doubled, with approximately 49,000 currently in use. Passenger distance has nearly doubled within the past year. And cargo traffic increased by twelve percent, and Sweden was ranked seventeenth in the world for port infrastructure quality. Maritime transport continues to enhance Sweden's transportation infrastructure.

Guidelines for the Growth of Transport Infrastructure

The Transport Infrastructure Development Policy outlines a long-term strategy for the existing transportation system. It is a plan for the advancement of transportation from 2 0 1 8 to 2 0 2 9 . The six-year-old action plan seeks to connect distances and modes of transportation. There is both long-term and short-term and medium-term planning in the development plan. The Implementation Plan will emphasize the participation of agencies, companies, organizations, the Federal Joint Funding Administration, and other relevant agencies in meeting the requirements of the European Union Directive (SERA). to Swedish national measures (The Swedish Transport Administration's market analysis, 2 0 1 9), with the subsequent development plans:

•Enhance the transportation system's digital and automated capabilities. By utilizing new technologies and evolving to a higher level continuously.

•Requirements for transport development call for more stringent emission reduction measures to reduce the climate impact of transportation systems and terminate the use of fossil fuels.

•Develop high-availability and transportation infrastructure to accommodate population growth. The expansion of the metropolis and the advancement of the economy. This will be accompanied by increased global trade and prosperity.

•Develop the transportation system to keep up with the accelerating social growth. This is because transportation plays a crucial role in addressing

numerous social issues, such as climate change. Nationwide housing, labor market, inclusion, gender equality, safety and security, and transportation services.

•Enhance the transportation system in response to the rising demand for social protection and robust transportation systems.

•It will encourage the transition of freight transportation from vehicle connections to rail transport. Expanding the road network to accommodate 7 4 -ton vehicles

•As a result of strong intercity connections, a new high-speed rail mainline has commenced expansion.

•Enhancing traffic safety for Vision Zero. • Promoting urban sustainability. urban environment accord Promote increased use of public transportation and cycling.

Considering the stages of the development plan from Figure 8.

The Owner's Goals and Requiremnts	Long-Term Governance	Operational control
• Transport policy goal • Orientation plans • Infrastructure Bill 12-year vision	• Action planning 12-year vision • Implementation plan 6-year vision	• Operational planning plan 1-4 year • Implementation up to 1 years
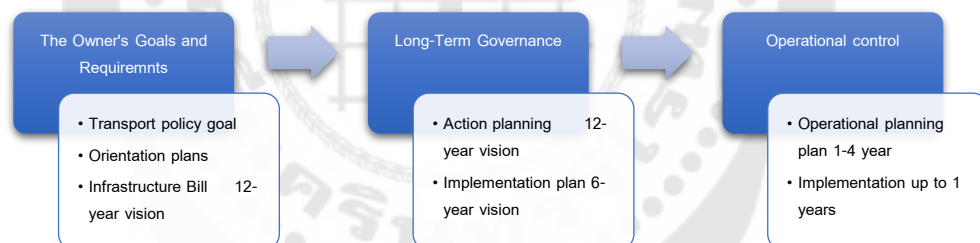
Figure 8 Shows the goal's link from start to action.

Source: Determined by researcher

The requirements for transportation systems, as well as the requirements for the physical design and operation of transportation systems, are subject to continuous and rapid change as a consequence of changes in requirements. These are the necessities for the transportation system: Expand the regional transportation infrastructure within the urban rail system. New trade models and the construction of

new cargo terminals result in new or modified transportation flows. and investment in innovative new vehicles. promote increased demand Create the necessary infrastructure to reduce travel time between cities. Enhance the productivity of transporting products on longer rail lines. wider as well as a transportation system that enables expedient travel between home and work. traffic development augmented maintenance efforts augmented railway maintenance New railway investments and railway expansion.

The outcomes of the development plan's implementation

The outcomes of implementing the Swedish development plan. There was an increase in the proportion of preventive maintenance. Reduce the amount of required corrective maintenance greater focus on the city's environment, accessibility, and security. There are environmental infrastructure measures that prioritize reducing the future climate impact of the transportation sector from current levels. In addition to improving housing construction conditions, certain areas are being developed, such as enhancing conditions for increased public transportation and safe cycling in areas of optimal safety. positive urban environment Bike lanes are being expanded. Benefit from a more effective transportation infrastructure. integrating public transport and environmental policy When individuals can effectively utilize the road. Additionally, the transportation system promotes the development of housing. The effectiveness of facilitating the shipment of products has increased. from integrating road and rail transportation Inaugurated longer and larger rail lines, and developed the western and southern primary lines into high-speed lines. New main roads are being constructed with all modes of transportation in mind. to create a sustainable and efficient transportation system.

Problems and factors supporting infrastructure development strategies for transportation

Despite the overall soundness of the economy However, the Swedish infrastructure investment climate is unfavorable. particularly regarding the railway infrastructure Even though Sweden's transport infrastructure is ranked 22nd in the world in the 2018 Global Competitiveness Report, its railway infrastructure rates significantly lower than its road infrastructure. Moreover, it is relatively minimal in light of Sweden's

impressive transport performance. The government intends to transfer more traffic from roads to rail and shipping. This will reduce the impact of transportation on the environment. Approximately 90 percent of the nation's products are transported by road at present. Changing to alternative modes will necessitate a substantial investment. Moreover, energy efficiency and sustainability in transport, despite having the highest proportion of renewable energy in the EU's transport sector. However, transportation continues to rely heavily on fossil fuels. in order to increase energy efficiency and decrease emissions A holistic strategy is required. Sustainable biofuels can be beneficial. Nevertheless, the electrification of the rail network has a significant improvement influence.

Belgium

Belgium's transport infrastructure is efficient and effective, fostering economic activity and growth. Transport infrastructure development can facilitate international competitiveness and economic expansion. Because Belgium's economy is modest and open. It has significant potential from the outflow of global economic activity and international trade and is highly integrated into the global economy. Belgium is ranked among the top 2 0 most competitive nations (KOF Swiss Economic Institute, 2013) and is the most international country in the globe.

Overview of Transport Infrastructure

The openness and dependence of the Belgian economy on the global economy are also significant sources of wealth. which has high-yielding connections throughout the globe Belgium's location in the center of Western Europe, where 8 0 percent of Europe's purchasing power resides, is unparalleled. Less than 800 kilometers from Brussels (Belgian Foreign Trade Agency, 2 0 1 4) is a significant opportunity as a gateway to Western Europe. These economic characteristics and geographical location encourage numerous foreign companies to establish subsidiaries in the Belgian market. for such a free-market economy Regional and global connections facilitated by an efficient and effective transportation infrastructure are a valuable economic resource. Belgium is another country with a higher proportion of passenger transportation by rail

than the majority of EU nations. However, less than road transportation. As for the transport of products, water transport predominates over road and rail

Improvement of the logistics sector in 2018, Belgium ranked fourth in logistics efficiency, an indication of continued improvement in logistics efficiency. After a minor decline between 2014 and 2016, the logistics sector's overall performance is high in comparison to other nations. But Belgium has a higher rate of road fatalities than the EU and its neighbors. The number of fatal incidents on highways is significantly higher than the average for the EU. Moreover, the proportion of cyclist fatalities is steadily rising. Additionally, there were reports of relatively low seat belt usage. alternative fuels for vehicle transportation in the past four years, there has been a significant increase in the use of alternative fuels in new passenger cars sold in Belgium, with each region implementing its own support measures. This could contribute to market fragmentation. While the policy emphasizes on promoting the use of electric cars, it also includes provisions for hybrid vehicles. The government has a policy of providing a 30% tax credit to citizens who purchase electric vehicles.

Guidelines for the Growth of Transport Infrastructure

The government Infrastructure Development Strategy for Transport in Belgium Plan for Intelligent transport systems (ITS) divide ITS responsibilities among regions and federations. in the context of the Belgian Federation, and is coordinated by the Belgian ITS Supervisory Board. It is governed jointly by the Federal Government and three regions: the Brussels Region (capital), Flanders, and Wallonia, with areas of responsibility including telecommunications, networks and operations, railways, aviation, and safety and security. road Federal agencies care about road infrastructure, road safety, inland waterway transport, and public transportation (other than railroads) because of car and truck registration. Consequently, Brussels, Flanders, and Wallonia are liable for ITS activities within their respective jurisdictions. The ITS Steering Committee is responsible for monitoring and exchanging technical and legal information regarding ITS in order to deliberate, coordinate, conform, and cooperate on all matters. In 2019, the "Good Move" regional initiative was devised and adopted. The plan is both

operational and strategic. It is a plan for the next ten years to provide an innovative and consistent response to mobility's challenges. To enable citizens to choose the most expedient mode of transportation each time they travel. As a metropolitan region, urban infrastructure congestion presents obstacles that must be addressed. Including a secure parking lot. including the reduction of commotion and pollution. To be a conveyance and mobility system that is intelligent. On the basis of a sustainable travel model, make it more of a digital transportation system that takes into consideration the quality of life of the people.

The Avoid-Change-Improve (A-S-I) strategic approach seeks to reduce unnecessary travel demands. Increasing the transport efficacy of each mode of travel while promoting travel in its various forms. The conveyance of both passengers and freight. enhance energy efficiency decrease emissions Enhance operational effectiveness, accessibility, and security. (Especially target populations such as those with mobility impairments)

A (Avoid/Reduce)	S (Shift/Maintain)	I (Improve)
Avoid or Reduce the need to travel	Shift or Maintain share of more efficient sustainable modes	Improve vehicle technology and the efficiency of transport modes
System Effciency	Trip Effciency	Vehicle Effciency
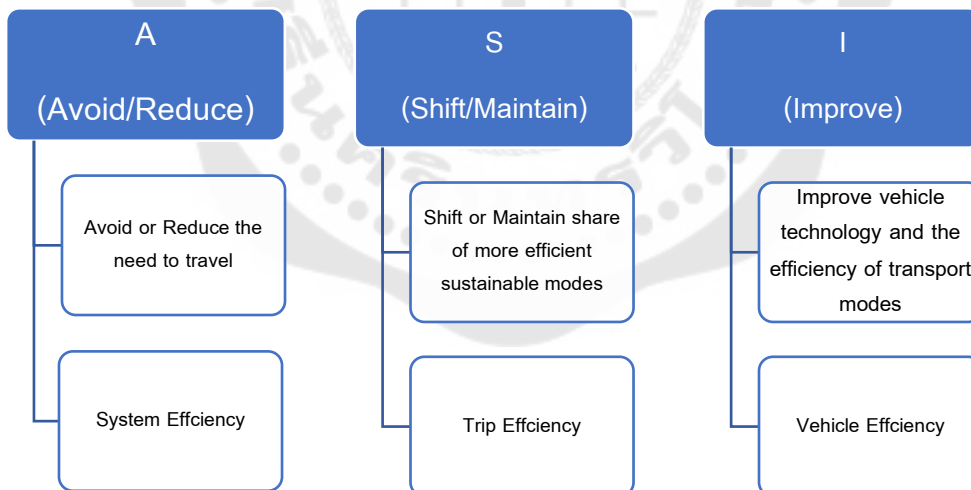
Figure 9 shows the development plan of the transport infrastructure

Source: Determined by researcher

The formulation of the plan will define policy specifics by 'transforming' and 'improving' in order for the federal government to accomplish innovative solutions to the congestion issue. Problems with traffic safety and the negative environmental impact of the transportation industry It will prioritize fundamental security. Prioritizing (walking and bicycling) over public or shared transportation (bus, train, car-sharing, etc.), such as through the development of multimodal travel information services. The successful development of the Belgian National Access Point has been supported by monetary and human resources. according to the European Commission's strategy Long-term, more drivers will have access to connected, autonomous, and autonomous advanced driver assistance systems (ADAS) in terms of digital transportation. Driverless vehicles can make this a reality. fewer traffic fatalities, less air pollution Beginning in 2017, there are multiple long-term strategies and action plans for the period 2030-2050. Important advancements include:

A. Expand connected infrastructure - central system connection of traffic signals - central system connection of detectors

B. Expansion of the camera network - Implementation of low emission zones - Connection of ANPR cameras utilized in restricted access zones

C. Tunnel Enhancements - New Equipment Installation - More Powerful Remote Control

D. Update to open data

- new datasets are published.

- Affiliated with the National Access Point

E. New mobility control system - Small mobile operator regulations

The outcomes of the development plan's implementation

The implementation of the Belgian Transport Development Plan has resulted in significant advances in ITS regulation. utilizing a car, and notably single-occupant cars), a Belgian Railways initiative. There have been significant advancements in terms of passenger comfort. Specifically in terms of (real-time) travel, information services, and multimodal e-tickets. Aims to be a pioneer in the advancement of

automated vehicle testing. A shuttle between public services and transportation is introduced as a pilot initiative for Belgian public road transport. Furthermore, there are numerous types of traffic management services. (Smart Truck Parking) Since 2018, Antwerp has utilized a traffic light coordination center and dynamic traffic management. Introduction of intelligent traffic signal control the caliber of Belgium's transportation infrastructure is high. There is a dense road and rail network, and the port infrastructure provides support. It is well integrated with Europe's main transportation infrastructure. According to the World Economic Forum, the caliber of global transportation infrastructure is very high. Its port infrastructure has been highly regarded throughout the years and received a high classification from the World Economic Forum. In contrast, Belgium scored poorly in terms of road quality and rail efficacy. Low government investment in road maintenance may be a contributing factor to the poor character of the nation's roadways. This is the consequence of policy decisions made within the context of prolonged consolidation. According to OECD data, only about 0.4 percent of Belgium's GDP is invested in transport infrastructure. Major economic centers can have a negative impact on the perception of road infrastructure quality. Belgium is among the most populous nations in Europe. The efficiency scores for rail conveyance are relatively low. Passenger satisfaction with the punctuality and reliability of Belgian rail services is lower than EU averages.

Problems and factors supporting infrastructure development strategies for transportation

Problems and Supporting Factors for the Plan for the Development of the Belgian Transport Infrastructure, Issue 1 Effective Management of Infrastructure to Reduce Congestion The infrastructure for conveyance is highly developed. However, increasing volumes of traffic and freight place them under increasing pressure. This has caused congestion and decreased air quality in urban cores. A more systematic cost-benefit analysis would be advantageous when investing in the resolution of obstacles. The currently active investment option would benefit from improved coordination between the central government responsible for rail and the regional government responsible for roadways, ports, and waterways. only one response the volume of traffic

is increased by substantial travel subsidies. and the cost reduction strategy is Developing congestion pricing for both road and rail transport to reduce congestion and address negative external factors in terms of economic impact and environmental impact. Targeting investments in bottlenecks and alternative modes of transport is another method for relieving pressure on the transport system. Although average road network usage is relatively modest. However, transport is typically concentrated in Brussels and Antwerp.

The purpose of investments in inland waterways is to shift freight transportation away from roads and railroads.

Issue 2 : Urban passenger transportation service competition In all three regions of Belgium, regulatory standards are stringent. Quantitative restrictions apply to specific Services. Passenger rail and intercity transport services are unable to compete.

Issue 3 Transport public in Wallonia Wallonia's public transportation system has potential for improvement. Due to Wallonia's low population density, the expense of public transportation is structurally significant. The multi-year absence of costly planning and transportation disruptions impede the operations of TEC, the principal regional and urban transportation provider. Access to challenging employment areas is a significant concern for job seekers. and raise Belgium's already considerable tax rate.

Austria

Austria is the country reputed to have attained logistics excellence. The most significant technological advancements include digitalization. Transport elements are automated by artificial intelligence and the internet of things. Create a significant competitive advantage It demonstrates Austria's remarkable accomplishments in logistics and infrastructure. Austrian logistics hotspots and innovation. The strength of diverse modes of transportation Austria's wide variety of educational opportunities in the subject of logistics. internationally significant study at Diverseness of a flourishing logistics startup community.

Overview of Transport Infrastructure

Overview of the Austrian transport sector: 11.4 percent in 2016. Austria has the greatest proportion of passenger transportation by rail among EU nations. (EU average 7.6 per cent) In 2016, rail played a considerable role in the transportation of freight (28.4%). Thus, it appears that the proportion of transport modalities between roads and trains in Austria is roughly equivalent. however greater than the EU average. Austria has an aggressive transformation policy. The cost of transporting products by road is quite expensive. road tolls are collected while rail freight is subsidized. In order to make diverse transport more appealing to facilitate the loading and transportation of single trucks or trucks on rails. Austria has a mortality rate comparable to the EU average. The rate of fatalities among motorcyclists is among the greatest in the European Union (20 percent, compared to the average of 15 percent). The primary causes of accidents continue to be careless driving and disregard for speed. limited In Austria, three out of every four fatal road accidents occur in rural areas. alternative fuels for vehicle transportation Overall, a small percentage of passenger cars utilized alternative fuels. While the proportion of new passenger vehicles fueled by alternative fuels is significantly increasing. The Austrian government encourages the use of electric vehicles by exempting their owners from the vehicle tax. And the rail freight market has been opened to competition to a greater extent than the passenger market. since the market share for everyone with the exception of the primary rail freight carried out in 2016, this figure was as high as 26 percent, while the passenger side of the freight sector was 11 percent. This level of market liberalization is modest in comparison to other EU nations. However, market prospects in the Austrian railway sector have improved. In 2010, the total market share of the railway business excluding the core was 15% for cargo and 5 percent for passenger transport.

Guidelines for the Growth of Transport Infrastructure

The 2040 objective of Austria's 2030 master plan is to attain a climate-neutral transport sector. Combination of averting traffic and travel time Rerouting and optimizing the performance of each mode of transportation. Create travel convenience, reduce travel time on long-distance routes, and prevent traffic congestion and

accidents. Highly effective mode of public conveyance Despite the fact that road transportation will become predominantly electrified, electric rail will remain one of the most energy-efficient rails. Develop modes of passenger and cargo transportation. The use of battery electric vehicles for personal travel is encouraged. And public transportation will emphasize train travel. Reduce air pollution to reduce energy consumption. naturally Each mode's energy efficiency is highly dependent on utilization conditions. In the freight industry, rail freight is predominant, and the cost of rail transportation consumes on average less than one-third of the energy consumed by the most energy-efficient electric lorries. Maintaining passenger and cargo transport at minimal energy costs is a growth opportunity. If the volume of passenger movement increases marginally with the volume of transport per capita, it decreases with population growth. If so, it will contribute to moderate freight growth. In addition, there will be a policy to digitize transportation, utilizing new technologies and mobility services that have the potential to transform automobile-based traffic into a new mode. to promote the growth of all public transport systems on short distances, freight transport has shifted from road transport to rail or water transport. to moderate but still demanding as a viable alternative, it is also appropriate for small businesses, requiring no logistical changes or additional investment. Road and additional measures to shift traffic on long-distance routes to rail and water are possible and necessary; the greater the proportion of rail freight to total freight traffic, the greater the freight volume, which includes cross-border transport. Because it accounts for 80 percent of Austria's transportation traffic. This implies that if Austria can increase its rail transport capacity, it will be able to significantly increase its rail transport share. For instance, the Master Plan's 2012 target of 40 percent can only be met if action is taken. Cooperating throughout Europe by establishing the imperative to improve the efficiency of international rail freight immediately and by instituting comprehensive cost transparency for all modes of transport. However, the number of rail systems will need to be increased to accommodate this increased shipment volume. Additionally, to improve the efficacy of

various modes of transportation. including rail and water conveyance throughout the multimodal transport chain to attain long-term carbon-neutral objectives.

Through "transition traffic" (avoiding and rerouting traffic) and "energy transition" in transport (enhancing fuel elimination), the objective is to achieve a climate-neutral transport sector. The "transformation mobility" required to reach our mobility system objective in passenger transport by 2040 will be accomplished by increasing the expansion of accessible public transportation for all settlement areas relative to the current plan. Expansion and allocation of bicycle and bicycle traffic areas. For freight transport, we will accomplish this by increasing cost transparency across modes (e.g., by permitting real comparisons between roads and rails), which increases efficiency throughout the transport chain, and by establishing ourselves as a strong partner.

The outcomes of the development plan's implementation

Austria's consumer contentment with public transportation is among the highest in the EU and has increased from 2013 to 2017 relative to other EU countries. Austria is among the nations with the highest use of renewable energy in transportation in 2016 (10.6%). The quota system is the primary support program for renewable energy sources used in transportation in Austria. The program requires companies that import or produce gasoline or diesel to guarantee that a certain percentage of their annual fuel sales are comprised of biofuels. choose Specifically, Austria's railway infrastructure is among the most developed and efficient in Europe. Austria's perception of the standard of its transport infrastructure places it among the top European nations.

Problems and factors supporting infrastructure development strategies for transportation

issue number 1 : Problems and Supporting Factors for Transport Infrastructure Development Plan in Austria Road Security Significant are Austria's efforts to achieve the self-defined goals of the Transport Safety Program 2010-2017. Although the project expects to halve the number of fatalities by 2020, this objective appears challenging as the number of fatalities remains above the target (a 25 percent decline from 2010 to 2017),and implementing road safety and security is one of the key areas

for the Smart Transport Directive's implementation. Priority areas in the Austrian Directive Action Plan have seen little activity thus far.

Issue 2: Market competition for passenger trains with the implementation of the Rail Plan, the introduction of public service contract tenders should enhance the long-term competitiveness of public passenger transportation services. So far, public service contracts (approximately 7 0 % of the passenger market) have been awarded directly. Currently, at least nine competitors in this market segment are losing market share. And the major players continue to hold a larger market share.

Issue 3: Navigation of the Danube River for water conveyance presents a problem. The primary concern is promoting terrestrial navigation. international conveyance the problem of navigating the Danube is also problematic, especially in terms of mitigating risks associated with inundation and low water episodes.

Issue 4 : Alternative energies promotion the proportion of vehicles with alternative fuel engines remains lower than in other EU nations. Still, the number of plug-in charging stations per plug-in electric vehicle falls short of demand. Despite Austria's efforts to reduce carbon dioxide emissions, taxes on transportation fuels remain relatively modest. It is still conceivable to use an environmental tax to advance Europe's 2 0 2 0 and beyond objectives. There is a bonus for electric vehicles. However, there should be more alternative propulsion systems.

Japan

The modernization of Japan's infrastructure was accomplished in a brief period of time, laying the groundwork for its economic expansion. With exceptional originality comes the ability to adapt to extreme environmental changes. and the concept of efficient use of limited (natural) resources, combined with the technological capacity to materialize concepts. The economic efficacy can be measured by the expansion of all infrastructure and economic growth.

Overview of Transport Infrastructure

Japan has one of the most advanced transportation infrastructures in the world, with nationwide coverage for urban and regional transport as well as long-distance transportation. Japan has a national railway network of 2 0 ,1 0 0 kilometers

(Japan-JR Railways, including conventional and high-speed trains) and a road network of approximately 1.2 million kilometers, including expressways (7,641 kilometers) and national highways (54,736 kilometers) throughout. until provincial roads (approximately 130,000 kilometers) and municipal roads (approximately 1 million kilometers). There are 97 airports and 994 terminals throughout the nation (Ministry of Land, Infrastructure, Transport, and Tourism, 2018). Since Japan's industrial development in the late 19th century, particularly after World War II when the country experienced economic growth, Japanese citizens have benefited from a fast, efficient, and innovative transportation network and system that enables them to travel in the quickest and most convenient manner possible. In terms of product delivery punctuality, swiftness, and care, Japan's logistics development is unrivaled on a global scale. Utilizing science and technological advancements to improve logistics management. Moreover, Japan is regarded as a country with standards in a variety of fields. Acceptance, which is regarded as an international standard and covers all facets of the logistics process, is used in other countries.

Guidelines for the Growth of Transport Infrastructure

Strategy for Transport Infrastructure under Japanese Government Policy Focusing on and giving priority to fostering cooperation between the government sector and relevant private agencies in order to comprehend government policy is a government priority. fostering investment partnership between the public and private sectors Including the standardization of logistics throughout the nation. The five divisions of Japanese logistics standards are as follows:

1) Enterprise-level criteria

2) Industry-wide benchmarks

3) National Specifications

4) Standards shared by nations or economies

5) International specifications

The establishment of Japanese logistics norms It emphasizes the use of technology and systematic database administration by employing Electronic Data

Interchange (EDI), which not only helps standardize data but also facilitates data management. minimize mistakes Reduce work hours and management expenses. This ultimately leads to efficacy in the supply chain's logistics activities. The framework for the development of Japanese logistics standards in three domains are as follows:

1. Equipment & Physical Connection

Japan promotes the Environmental Standards Policy or Environmental (JIS) under the concept of "Basic Policies for Economic and Fiscal Management and Structural Reform 2002" by emphasizing the use of environmentally friendly and safe products and supporting the 3 Rs (Reuse, Recycle, and Reduce) for people's health. Environmental JIS has seven aspects, including engineering and architectural standards. Material specifications machine specifications Data and electrical specifications Consumer product standards and safety environmental and refuse regulations and transportation and distribution regulations A logistics-related test, such as a hybrid car's fuel combustion, prompted the development of a strategy to increase the efficiency of product distribution and logistics. Promote the idea of unit loading to facilitate the transportation of products. Japan attaches great importance to promoting the construction of logistics infrastructure, issuing measures to support 24-hour port openings, and promoting efficient transport connections.

2. Information connection (Communication)

The Ministry of Economy, Trade, and Industry (METI) has examined the standardization of information connectivity as part of a plan to enhance the effectiveness of product distribution and logistics. Communication system and instrument for data management. Utilization of information technology (IT), including the Internet, EDI system, RFID system, and other logistics database systems. for domestic consumer benefit the various measures outlined in METI's development plan seek to advance business operations by increasing supply chain efficiency through the application of information technology. Starting exclusively with information technology within the organization Increase cooperation with supply chain organizations, including

manufacturers, wholesalers, and retailers, and expand expansion to affiliated organizations.

3. Regulations and Rules

Japan was the first country in the world to establish fuel efficiency standards in 1979, when it enacted the Act on the Rational Use of Energy Logistics Standardization (Energy Saving Act) to develop cargo-specific fuel efficiency standards for industrial vehicles. Japan issued the Top Runner Standards in 1999 in an effort to develop technologies and fuel-efficiency suitable for commercial vehicles. The Next - Generation EFV Development and Commercialization program was established so that users could choose vehicles with energy-saving and fuel-efficient characteristics. to conduct research and development Low emission vehicles do not contribute to the reduction of urban pollution. stop global warming Reduce oil consumption in conveyance. and switching to renewable energy Support for low-emission vehicles does not harm the environment and decreases the number of large diesel-powered vehicles like lorries, buses, etc. Japan's transportation industry is attempting to reduce emissions. carbon dioxide emissions Through the distribution policy (Distribution Policies) as a measure to combat global warming (Global Warming) in order to meet the Kyoto Protocol's objectives, reduce global warming problems for efficiency. In 2005, MLIT initiated the Green Logistics Partnership Conference to assist the private sector in developing Green Logistics and, ultimately, in reducing greenhouse gas emissions. Exchange of best practices for the development of environmentally sustainable transportation policies in each nation. The Japan Institute of Logistics Systems (JILs) has a safety-related logistics concept. Besides logistics facilitating economic activities. There are also concerns regarding health, quality of life, and safety. from minimizing transportation accident rates.

The outcomes of the development plan's implementation

In addition to preserving the environment for sustainable development, Japan seeks to increase logistics efficiency by promoting the Door-To-Door transportation system and the development of Multimodal Transportation. Building

transportation facilities in accordance with international standards with the aid of technological innovation. Japan employs technology that suits the requirements of each nation and region. It enables rapid construction under constrained conditions and provides technology to mitigate local environmental threats. Its primary objective is to contribute to the creation of economic infrastructure that will benefit citizens over the long term and contribute to the global development of infrastructure. A summary of the standard of Japan's transport infrastructure According to the 2 0 1 8 Global Competitiveness Report by the World Bank, Japan's logistics-efficient transport infrastructure rates fifth in the world and first in Asia.

Problems and factors supporting infrastructure development strategies for transportation

Transportation infrastructure of Japan the primary issue is Japan's massive natural disaster. As road and rail infrastructure comprise the ground transportation network, a significant portion of the nation's transport infrastructure has been repeatedly impacted and devastated by numerous natural disasters. It is probable that damage to road and rail infrastructure will be greater than damage to port and airport infrastructure, such as damage to road and rail infrastructure. The road affects various sections. In contrast, damage to airports and terminals is typically limited, as this infrastructure continues to grow. Local transport focuses on air or sea services, but inherent measures can mitigate infrastructure damage. Natural catastrophes cannot be predicted. Natural Catastrophes Causing Sudden Planning and Reconstruction in such Cases Readiness and effectiveness of the long-term strategy This can be accomplished uniquely for each mode of transportation.

Road Office of the Department of Public Lands Infrastructure, Transport, and Tourism (MLIT) has established significant earthquake targets for preventing earthquakes, heavy rainfall, and heavy snowfall. Therefore, road disaster prevention initiatives in Japan are subdivided into (a) earthquakes and tsunamis, (b) heavy rains, and (c) heavy snow and cold temperatures. (Including surface freezing protection) to ensure the safety and dependability of the road system. exemplary highway construction as roads play an essential role in disaster relief, a ring road has been

constructed around the city, along with other roads for disaster prevention. On the roads, steps have been taken to mitigate and prevent damage from earthquakes, cyclones, and heavy snowfall. Approximately 2 3 % of the time, a magnitude 6 . 0 or greater earthquake will occur. In addition to accelerating measures to prevent bridge collapse, MLIT has expedited other seismic prevention measures. To protect significant surface gaps on expressways and national highways under the jurisdiction of MLIT. Including support reinforcement and replacement. Considering the likelihood of a significant earthquake in particular, bridges are reinforced for rapid repair. as well as other measures that cannot be enhanced.

Thailand

Thailand in freight forwarding is a service that plays a significant role in the distribution of goods on both domestic and international markets. Freight forwarders are responsible for transporting products throughout the entire supply chain. (From basic materials or initial products) intermediate product and final product. Therefore, the business situation depends on the quantity of goods, which fluctuates according to the country's economic situation. There are five distinct modes of transit for goods in Thailand, the first of which is road transport. It is transported by a variety of truck models. (2) Transportation by rail or rail system. It is a cargo railway. There are numerous routes and modes of transportation. State Railways of Thailand (SRT) is the only service provider. (3) Pipeline conveyance It refers to the transportation of liquids such as water, oil, natural gas, and compounds, among others. (4) Transportation by water It is primarily utilized for transporting large cargo and (5) air transportation. It is frequently valuable cargo. A significant percentage of Thailand's freight is transported via road. 7 9 . 7 percent of cargo volume Because the government prioritizes the construction of transportation infrastructure over other forms. Consequently, the road distance encompasses 91.6% of the nation's total transportation routes. With the nature of road transport that can be delivered directly from the sender (or origin) to the recipient (or destination) (Door to Door Transport) and other forms of transport links that

cannot provide complete transportation from origin to destination (Incomplete Transport), Door to Door Transport is the most efficient mode of transport.

Overview of Transport Infrastructure

Thailand concerning transportation infrastructure, the government is devoted to its sustainable development. to create a transportation infrastructure, Connect land or road, rail, marine, and air transportation. This will expedite the dissemination of prosperity to all regions of the nation, including Bangkok and its environs. and in various regions for the development of rail transport, the Bangkok and surrounding area electric train system has been developed. urgently to encourage the rail transport system to become a public transport system and to address traffic congestion in a concrete manner. There is a proposal to expedite the completion of the construction of 14 electric train routes with a total length of 554 kilometers, of which two will be operational this year. The monorail project (Monorail), the Pink Line (Khae Rai - Min Buri) and the Yellow Line (Lat Phrao - Samrong section) will be completed by the end of 2023, along with the development of Bang Sue Central Station. to become the greatest railway hub in Thailand and ASEAN Considered a smart station prototype with Thailand's first 5 G infrastructure. Asia and Southeast In addition, driving high-speed trains, the Hi-Speed Train, along the Bangkok-Nakhon Ratchasima-Nong Khai route in the northeastern direction. Phase 1, Bangkok - Nakhon Ratchasima, 253 kilometers, is anticipated to open for service in 2026, while Phase 2, Nakhon Ratchasima - Nong Khai, 356 kilometers, will open in 2027. 2028 Section of Eastern Route A high-speed train linking three terminals. Using a maximum pace of 250 kilometers per hour, Don Mueang-Suvarnabhumi-U-Tapao will connect Bangkok and the Eastern Special Development Zone (EEC) over a distance of 220 kilometers. Currently, 100 percent of the area can be transferred over to prepare for construction, and Phase 2 of the 167-kilometer double-track railway project from Khon Kaen to Nong Khai will be operational in 2026. Already four double-track railway projects have been built. Specifically, 1) Map Kabao - Thanon Chira Junction, 2) Lop Buri - Pak Nam Pho Section, 3) Nakhon Pathom - Hua Hin

Section, and 4) Prachuap Khiri Khan - Chumphon Section (Department of Public Relations, 2022).

Road Infrastructure There are currently 66,940 kilometers of roads under the supervision of the Department of Highways in Thailand (including intercity motorways), 47,916 kilometers of roads under the supervision of the Department of Rural Roads, 207.90 kilometers of roads under the supervision of the Expressway Authority of Thailand, and local government roads. In 2020, the trend of travel and road transport will increase by 21.84 percent, or 3.07 million people per trip, resulting in an increase in traffic volume, particularly in the area surrounding Bangkok and on the main roads connecting the country's regions (Office of Transport and Traffic Policy and Planning, 2022).

It has increased the sea transportation potential of Laem Chabang Port, Phase 3 , promoting the Eastern Special Development Zone (EEC) project, which is scheduled to open in 2025, and Map Ta Phut Industrial Port, Phase 3, a gas transfer hub. In 2026, the Liquefied Natural Gas or LNG Hub will be operational in the CLMV nations of Cambodia, Laos, the Union of Myanmar, and Vietnam. The aviation industry as a whole has constructed terminals across the nation to accommodate the growing number of passengers adequately. While Suvarnabhumi Airport, Phase 2 opened for service in October 2022, U-Tapao International Airport was also constructed. In addition to supporting economic activities and tourism in the Eastern Special Development Zone (EEC) initiative, the U-Tapao Aircraft Maintenance Center will be constructed. Promote Thailand's function as a regional aviation hub and Aviation Center.

Guidelines for the Growth of Transport Infrastructure

Thailand's strategy for transport infrastructure development Establish a 20-year logistics system development framework, dividing the development period into three phases: Phase 1 , the first 5 -year period of the 3 rd Strategic Plan for Thailand's Logistics System Development (2017 -2021) , to set the groundwork and propel development. Define the strategic position for regional connectivity and trade gateway to improve supply chain management. Develop the National Single Window system

(NSW), which is a service system connecting government agencies and business sectors (G2G, B2B, and B2C) for import, export, and logistics. Support for international data connections ASEAN members and other regional countries to be fully interconnected and the legal framework to support electronic transactions to be enhanced; (3) the development of professional standards for logistics and logistics personnel that meet international quality standards. To prepare Thailand for a stable, prosperous, and sustainable transition from middle-income to high-income status (Federal Minister of Transport and Digital Infrastructure, 2021).

Phase 2 (five to ten years): A plan to propel Thailand's development to become a sub-regional and regional trading hub. Connecting commercial transactions via electronic commerce (E-commerce). Developing the logistics system into a form of electronic data linkage, also known as E-logistics, in order to increase the productivity of entrepreneurs' production, service, trade, investment, and logistics operations. Eliminate impediments and facilitate pertinent components to achieve a balance in the development of structures and systems (hardware), such as by enhancing logistics systems in finance and customs. As well as developing the potential for conducting business internationally, supporting factors (Software) such as adjusting various regulations to be conducive to business operations trade and investment and personnel (Human Resources), such as the development of entrepreneurs and labor to have knowledge and skill skills, are essential.

Phase 3: ages 11 to 20: During the next two decades, the direction and strategic position of development will lead Thailand to become a high-income nation with equitable income distribution. To be the region's transport and logistics base A source of sustainable agricultural products drives Thailand's transition into a nation of trade and service (Trading and Service Nation). It is also a source of environmentally favorable industries that are highly innovative and creative. The approach to logistics system development is in accordance with the strategy of building competitiveness, with a direction framework to drive the development of Thailand into a trading nation as a trading center where Thai entrepreneurs are competitive on the global stage. Capitalize

on regional value chains and leverage digital economy and innovation development. (National Economic and Social Development Commission Office, 2020)

The outcomes of the development plan's implementation

Thailand Logistics Development Strategic Plan No. 2 (2013-2017) Implementation by relevant government agencies and private sectors Summarize the significant development outcomes in accordance with the assignment as follows: Development of the global logistics infrastructure The nation's logistics infrastructure is more efficient. Government agencies and the private sector collaborated in the past. Continuously, affiliated parties have propelled and developed the country's logistics system. In addition, the Thai business sector is more vigilant and lends importance to the organization's logistics management system development. As a consequence, the cost of logistics in Thailand has steadily declined from 17.1 percent of GDP in 2007 to 14 percent of GDP in 2015, and is projected to fall to 13.9 percent of GDP in 2016. The cost of goods transportation is 7.5 percent, the cost of inventory storage is 5.1 percent, and the cost of administration is 1.3 percent, and Thailand has the potential to increase its logistics competitiveness. Trade facilitation to become more productive Thailand's logistics operators have the ability to conduct business both domestically and internationally. Moreover, logistics personnel have been devised for increased efficiency. In 2020, Thailand's Logistics Competitiveness Index will rank higher on the International Logistics Efficiency Index (World Bank). Thailand's logistics costs (International LPI) and trade facilitation efficacy (World Bank International Trade Ranking (Trading Across Borders)) rank higher in 2021. In 2021, logistics costs will account for 12 percent of the gross domestic product at annual prices (the logistics cost-to-GDP ratio). issued electronically to 100 percent by 2021

Problems and factors supporting infrastructure development strategies for transportation

The entire country of Thailand is covered by an extensive road transport network. Capable of connecting transportation between different city groups until there is no longer a missing link (Missing Link). There is no need to establish a main link network in the next decade. On the other hand, traffic congestion and severe road

accidents have persisted for a long time and are likely to worsen in the future. Due to the fact that public transport networks in urban areas and between cities are not yet comprehensive and systematically linked, they are unable to satisfy the public's transportation needs adequately. Transporting goods and passengers on the transportation primary road at a rate that exceeds the road's current carrying capacity. In the past, budget allocations for road transport development focused on physical development (Route Development expanded traffic channels and road networks) as opposed to management and social development. (Educating create traffic discipline urban development control and legal oversight) causing the budget to be quite high and the inability to address the problem as effectively as it should be rail transportation. Currently, electric railway networks in urban areas are still limited. The majority of routes, 9 3 . 1 0 percent, are one-way, resulting in restrictions on the operation of trains, locomotives, and buses, as well as deteriorated, inadequate signaling system issues. The bus administration system is extremely out of date. The rail transportation system continues to rely on imported technology. Safety issues at the railroad crossing are always uniform. Connecting to the terminal is still cumbersome. As a result, rail transportation of people and commodities remains constrained. The government's intention to make rail the primary mode of transportation in the country is a significant barrier to changing the mode of transportation. Regarding the train station, it is not far from the station. Compared to the passenger terminal, which is a significant advantage in providing services to individuals along the railway line, the railway station has the following advantages: However, the connection between other modes of transportation's routes and stations remains inadequate.

Water transport It is the least expensive mode of transportation. However, there is currently a limited quantity of transportation. Because of restrictions on transport routes and linkages to other modes of transportation. Additionally, there is the issue of transportation pace. There are also physical issues with transportation routes, such as ditch depth, breadth, and curvature issues, as well as bridge height issues. environmental issues and climate concerns Regarding the problem with hinterland

connections, the lack of a strong back-harbour network will make water transportation unattractive to users. This is because of the necessity to increase transportation costs, such as double handling fees for loading and offloading between modes of transport. (transshipment) between domestic and international vessels, as well as between cargo ships and trains or vehicles.

Air transportation, air travel experiences the same congestion issues as road travel. Because the number of passengers exceeded capacity, the flight was delayed. The most essential factor is expansion. The rapid expansion of low-cost airlines has caused congestion and delays at major airports due to rising traffic volumes. While medium and small airports are not yet operating at peak capacity. Inadequate air transport and aviation infrastructure and facilities Lack of integration between airports and transport sectors as a result, cargo and travel delays are inefficient, diminishing a nation's competitiveness and transforming it into a gateway for air freight. Both the agency's strategy and its operations lack integration. resulting in development delay interruptions and redundancy Lacking an aggressive strategy to attract the attention of service users, it has a wide-ranging impact on development. Consequently, few consumers do not have complete access to the service. Laws, rules, regulations, and procedures are not yet international standards, which adds steps, causes inconvenience, delays, and increases costs for air transport and aviation businesses.

The evolution of transport infrastructure in Germany, Sweden, Belgium, Austria, Japan, and Thailand are compared

Construction of transportation infrastructure It is a significant contributor to economic expansion. by infrastructure for transport and economic prosperity It is an impressive expansion in the same direction. Employment results in the expansion of the manufacturing sector, leading to greater economic expansion. Transportation will have the greatest impact on sustainability. It contributes to the expansion of the nation's production capacity. enhancing the value of existing assets, The transport infrastructure development strategies of Germany, Sweden, Belgium, Austria, and Japan. Thailand is also a significant trading partner for the country. The primary objective of each nation's transport development plan is to achieve sustainable development, such as economic

growth. Focus on the environment and international competitiveness. Multimodal transport will be more efficient if an integrated, borderless transportation network is constructed. Balanced utilization of the logistics system for all products. Nonetheless, constant transport and the logistics strategy of each nation Not limited to simply modifying the mode of transportation. Nonetheless, the multimodal transport policy is also connected to measures that facilitate connection and cooperation.

- Effectiveness Achieving global competitiveness and implementing the logistics of the supply chain via continuous transportation from origin to destination. (Door-to-door) effortlessly

- Sustainability by enhancing the environment and society by utilizing multimodal transport systems more effectively

- Innovation Utilization of cutting-edge technology to facilitate and optimize multimodal transportation operations in accordance with international standards.

The above-mentioned five countries' policies for the development of logistics systems are regarded as development guidelines for determining key strategies in the development of logistics standards. However, each country has distinct development strategies and approaches based on the specifics of its context. Prioritizing investments in the necessary maintenance of existing projects.

Germany will concentrate on enhancements. To preserve the quality of the original undertaking, restore and maintain it. and expenditure on renewable infrastructure It is an initiative to upgrade and reconstruct a network of roads, railroads, and waterways. It focuses on evaluating projects that have significant capacity-building or quality-improvement effects and have a wide-ranging impact. Consider the construction endeavor as beneficial and necessary for the economy as a whole. The German transport network prioritizes the development of the primary structure, which is the main road's transportation. In tandem with the expansion of the highway, a motorway will be built to the suburbs and the state line. The primary objective is to eliminate traffic

bottlenecks that increase travel time. and increased transportation costs including problems with the environment

In Sweden, railroads are the primary mode of transport for the transportation of products. However, almost all of Sweden's domestic transportation relies on land conveyance. This prompted Sweden to develop a road safety policy known as "Vision Zero," a strategic approach to creating a safety system in which no one is at risk of death or severe injury while using road transportation. concentrating on the use of alternative energy to decrease atmospheric pollution The primary objective of Swedish transport development is the computerization of the transport system. Reduce the climate impact of transportation systems and terminate the use of fossil fuels by enforcing stricter emission reduction measures. Promote the transition of freight transportation from auto to rail. enhancing the road network for 74-ton lorries; expanding new high-speed rail lines to facilitate intercity connections; promoting the use of electric vehicles.

Belgium is a nation situated in the center of Europe. This is the entrance to Western Europe. These economic characteristics and geographical location encourage numerous foreign companies to establish subsidiaries in the Belgian market. Transport in Belgium is crucial for two primary reasons. The majority of passenger transportation utilizes road transit. And the cargo will be transported by ship. Promote travel in a variety of ways The emphasis on investments in inland waterways seeks to shift freight transportation from roads and rails to inland waterways. and increasing the efficacy of each mode of transportation. The conveyance of both passengers and freight. enhancing energy efficiency Reduce emissions and pollution, and improve operational effectiveness, safety, and accessibility. (Especially target populations such as those with mobility impairments)

The distribution of modes of transportation between road and rail in Austria appears to be roughly equivalent. Austria has an aggressive transformation policy. Emphasis on the development of rail transport through the collection of road tolls and the conversion of short- to medium-distance commodities transport from road to rail or

water. The primary objective of the policy is to make the transportation sector climate-neutral by 2 0 4 0 , thereby reducing its carbon footprint. Enhance the performance of every mode of conveyance. Create travel convenience, reduce travel time on long-distance routes, and prevent traffic congestion and accidents. Highly effective mode of public conveyance Develop modes of passenger and cargo transportation. The use of battery electric vehicles for personal travel is encouraged. And public transportation will emphasize train travel. Reduce air pollution to reduce energy consumption. Japan's transportation infrastructure is contemporary. as well as nationwide coverage for municipal and regional transport in addition to long-distance transportation.

Japan's national railway network is the most advanced in the world, particularly for high-speed trains. Until the nation which offers high-speed train service Concurrently, other areas of transportation have been developed in an efficient manner. Specifically, regarding punctuality, rapidity, and product delivery care. Using advances in science and technology to facilitate logistics management. The establishment of Japanese logistics norms It emphasizes the use of technology and systematic database administration by employing Electronic Data Interchange (EDI), which not only helps standardize data but also facilitates data management. minimize mistakes Reduce work hours and management expenses. facilitating effectiveness in actions the public sector in Thailand prioritizes the development of road infrastructure above all other forms. Consequently, the road distance encompasses 91.6% of the nation's total transportation routes. With the nature of road transport that can be delivered directly from the sender (or origin) to the recipient (or destination) (Door to Door Transport) and other forms of transport links that cannot provide complete transportation from origin to destination (Incomplete Transport), Door to Door Transport is the most efficient mode of transport.

Thailand

The transportation infrastructure of the government is committed to sustainability. to create a transportation infrastructure, Connect land or road, rail, marine, and air transportation. This will expedite the dissemination of prosperity to all regions of the nation, including Bangkok and its environs. and in various regions for the

development of rail transport, the Bangkok and surrounding area electric train system has been developed. urgently to encourage the rail transport system to become a public transport system and to address traffic congestion in a concrete manner.

The transport infrastructure development strategy of Thailand establishes a 20-year logistics system development framework, dividing the development period into three phases, the first of which spans five years. (3) Establishing global professional standards. To satisfy international quality standards for logistics and logistics personnel Prepare Thailand for the transition from middle-income to high-income status.

Phase 2 (five to ten years): A plan to propel Thailand's development to become a sub-regional and regional trading hub. Connecting trade transactions in the form of electronic commerce (E-commerce), E-logistics is the development of logistics systems into electronic data links.

Phase 3: ages 11 to 20: During the next two decades, the direction and strategic position of development will lead Thailand to become a high-income nation with equitable income distribution. To be the region's transport and logistics base Transforming Thailand into a Nation of Commerce and Service

Nevertheless, the aforementioned framework for the development of Thailand's logistics standards serves as a guide for each phase. which can be modified based on numerous variables, such as the outcomes of previous operations The urgency of process enhancements due to global factors or in accordance with the overall logistics development strategy. Additionally, Thailand is a developing or middle-income nation. This distinguishes the context for development from the five main nations with larger economic structures.

Table 9 compares the infrastructure development guidelines of Germany, Sweden, Belgium, Austria, Japan, and Thailand with those of Sweden, Belgium, Austria, Japan, and Thailand. As a consequence, the country's development plan may differ from those of five other nations.

Table 9 Comparison of Transport Development Plan Approaches from Germany, Sweden, Belgium, Austria, Japan and Thailand.

Country	Policy of Transportation	Outcome	Problems and factors supporting
Germany	Emphasis on investment in maintenance of existing projects that are necessary and investment in replacement infrastructure. and new construction projects on road, rail and waterway networks aimed at reducing noise. There are HGV parking spaces on the motorway. bike path on the motorway. Enhance transportation safety highway interchange and overpass expansion	Remove motorway bottlenecks over 2 ,0 0 0 kilometers. Reduce traffic delays by 160 million hours annually. The railway project allowed more people and cargo. Reduce operational and transportation costs	Restrictions on Public Borrowing Fundraising in Public Borrowing Existing budgets are insufficient to upgrade or have all new construction projects beneficial to transport policies and the economy as a whole.
Sweden	The so-called "Vision Zero" road safety policy is a strategic approach to a road transportation safety system in which no one is at risk of death or severe injury. designs for the utilization of alternative fuels in road transportation. in both public transportation and passenger automobile categories the objective is to connect distances and modes of transportation.	Preventive maintenance increases. Reduce maintenance. Urbanization, and safety have improved cargo transportation efficiency. linking road and rail transport	Sweden's infrastructure investment situation is unfavorable. especially about the railway system

Source: Collect by researcher

Table 9 Comparison of Transport Development Plan Approaches from Germany, Sweden, Belgium, Austria, Japan and Thailand. (cont.)

Country	Policy of Transportation	Outcome	Problems and factors supporting
Belgium	Intelligent transport systems (ITS) development plan to reduce unnecessary travel demand Promote travel in various forms and forms and improving the transport efficiency of each mode of transport. Both with the transportation of both passengers and cargo. improve energy efficiency reduce emissions	passenger comfort getting better Information and electronic tickets are available. automotive automation Launch a pilot program, Automated shuttles between public services and transportation, Smart Truck Parking Intelligent, traffic light control system.	The transport infrastructure has improved, but the traffic and freight volume has increased, the competitiveness of transport services is highly constrained, and the absence of multi-year costly planning and the disruption of transport.
Austria	Develop a climate-neutral transport sector by 2040. Reduce transport sector carbon. Improve the efficiency of each mode of transportation. Create travel convenience, shorten travel time on long distance routes, and avoid congestion and accidents. High-efficiency public transport develops modes of transport for both passengers and goods. Public transportation will focus on traveling by train. To reduce energy consumption, reduce air pollution.	People's satisfaction with public transport is high, one of the countries that uses the most renewable energy in transportation, has a highly developed and efficient railway infrastructure.	The number of fatalities is higher than the target, the passenger rail market remains monopolized and the proportion of cars using alternative fuel engines remains low, the number of electric vehicle charging points is still less than the demand.

Source: Collect by researcher

Table 9 Comparison of Transport Development Plan Approaches from Germany, Sweden, Belgium, Austria, Japan and Thailand. (cont.)

Country	Policy of Transportation	Outcome	Problems and factors supporting
Japan	Promoting public-private investment cooperation, focusing on the use of technology and systematic database management by using Electronic Data Interchange (EDI), which in addition to helping to manage data to the same standard, also facilitates data, reduce errors, reduce work time and reduce management costs, promote the Door-To-Door transportation system and promote the development of Multimodal Transportation. along with protecting the environment	Cargo handling standards, technology that best meets the needs of each country and region, addressing local environmental risks, modern transport infrastructure and nationwide coverage for long-distance transportation.	Japan has suffered a major disaster; its transport infrastructure has been affected and damaged by various natural disasters. Natural Disasters Causing Sudden Planning and Rebuilding
Thailand	Aiming to develop towards sustainability to create a transportation system that seamlessly connects land, rail, water and air transportation. Accelerate the distribution of prosperity to all regions covering the country. For the development of rail transport, there has been an urgent development of the electric train system in Bangkok and its vicinity in order to push the rail transport system into a public transport system. and solving the problem of traffic congestion in a concrete way	The country's logistics system is more efficient, Thailand's logistics costs are reduced to 12 percent of the country's gross domestic product in 2021. In addition, the number of import and export service transactions 100 percent electronically issued in 2021.	There are still problems with traffic jams and road accidents because the public transport network is not comprehensive and not systematically connected. Mainly used for road transport. which is more than the existing road capacity can support

Source: Collect by researcher

4.2 Analyze the economic impact of the Bang Pa-in - Nakhon Ratchasima intercity motorway project.

      4.2.1 Analysis of the production structure of the Bang Pa-in - Nakhon Ratchasima Intercity Motorway Project

          Production Structure of the Intercity Motorway Project Bang Pa-in - Nakhon Ratchasima line established that the investment in the construction of the project employs intermediate production factors valued at 231,485,989 million baht, accounting for 69.83 percent of the total production cost. (It is the intermediate factor produced in the nation and the quantity of primary production factors that are utilized. Or value added (Value Added) is 100,010,700 million baht, which is 30.17 percent of the total production cost value (composed of salary / wages / labor compensation 32.22 percent, production return (Operating surplus) 41.60 percent, depreciation 21.97 percent and net indirect tax 4.21 percent, as shown in Figure 10).

Value Added of Bang Pa-In-Nakhon Ratchasima Intercity Motorway Project
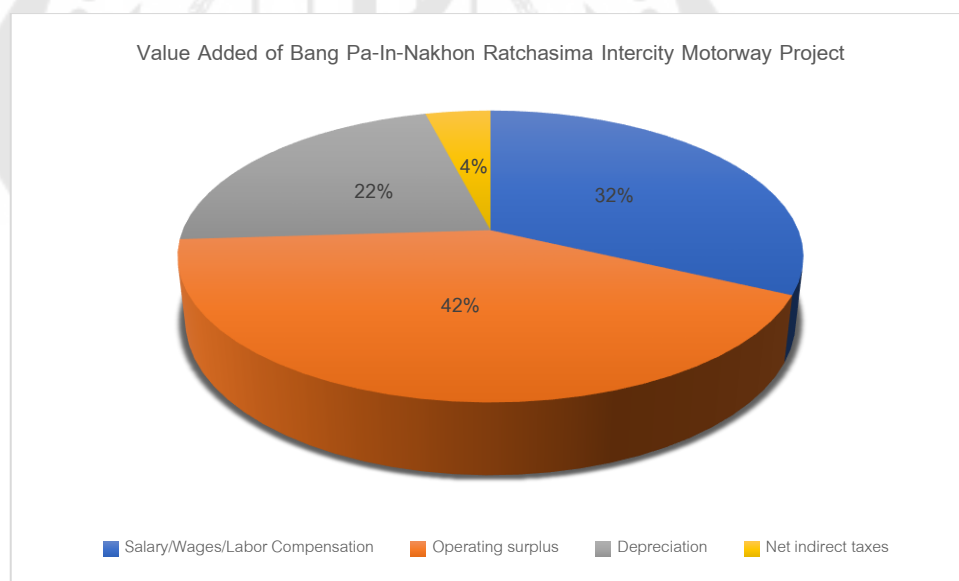
Figure 10 Value Added

Source: Calculations by a researcher

      The domestically produced intermediate production factors used in the construction of the Bang Pa-In - Nakhon Ratchasima intercity motorway. The consists of concrete product production (21,39%), quarrying and pulverizing (20.13%), steel

product production (14.73%), cement production (11.0%), and freight transportation. Land (7.06 percent) (Table 10)

Table 10 Production structure of the construction of the Bang Pa-in – Nakhon Ratchasima intercity motorway project (unit: million baht)

	Branch 1 production of concrete products	Branch 2 Quarrying and rock crushing	Branch 3 production of steel products	Branch 4 cement production	Branch 5 land transport	Branch 5 Bang Pa-in – Nakhon Ratchasima intercity motorway project
intermediate inputs (1)	56,129,527.00	26,843,591.00	87,574,716.00	72,264,587.00	197,915,369.00	231,485,989.00
Primary Inputs or Value Added						
1. salary / wages / labor compensation	8,313,724.00	9,730,312.00	10,121,584.00	10,081,827.00	22,456,537.00	32,219,226.00
2. Operating surplus	8,423,177.00	14,204,360.00	11,152,661.00	26,166,206.00	31,531,830.00	41,607,845.00
3.Depreciation	3,456,135.00	3,280,887.00	3,961,141.00	8,208,715.00	12,324,703.00	21,975,064.00
4. Net indirect taxes	2,161,591.00	764,279.00	3,308,900.00	3,241,537.00	7,889,262.00	4,208,565.00
Primary Inputs or Value Added (4)	22,354,627.00	27,979,838.00	28,544,286.00	47,698,285.00	74,202,332.00	100,010,700.00
Gross domestic production (5) = (1) + (4)	78,484,154.00	54,823,429.00	116,119,002.00	119,962,872.00	272,117,701.00	331,496,689.00

Source: Calculations by a researcher

Structure of Production and Distribution for the Intercity Motorway Project the Bang Pa-in - Nakhon Ratchasima line discovered that a production distribution structure exists to satisfy the ultimate demand in terms of total investment costs. 331 496 8 8 9 million baht. Total output owing to the construction of the Bang Pa-in - Nakhon Ratchasima Line intercity highway project It is an investment initiative for the development of the country involving the construction of public services (Figure 11)
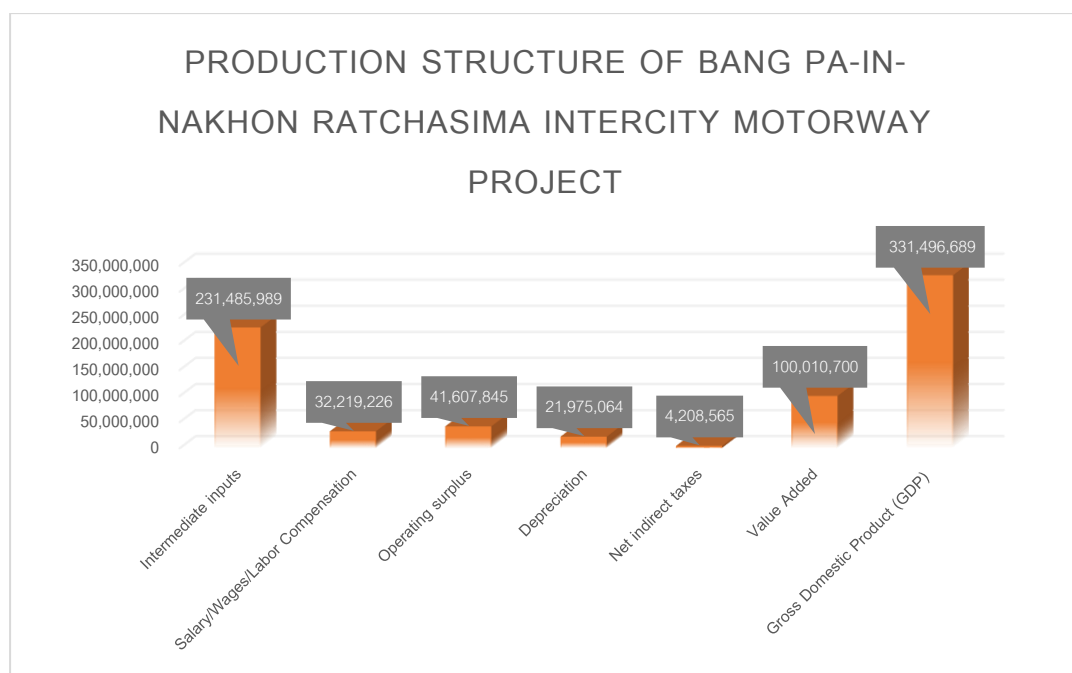
Figure 11 Structure of Production and Distribution for the Intercity Motorway Project the Bang Pa-in - Nakhon Ratchasima (unit: million baht)

Source: Calculations by a researcher

4.2.2 Forward and Backward Multipliers of The Bang Pa-in – Nakhon Ratchasima intercity motorway project

From the analysis of the table of production factors and output (Input-Output Table) of Thailand, 2015, size 180 production fields, determine the coefficient of production factors and direct and indirect output (Direct and Indirect Coefficient) or the coefficient of production and output. Input-Output Coefficient is the ratio between the output of a branch of production used as a factor in the intermediate production of

another branch and the total output of that branch. The coefficients of production and output can be represented by the matrix A, from which the inverse matrix of Leontieff's inputs and outputs (I-A) is derived. $(I - A)^1$ It illustrates the transmission effect of changes in final consumption (such as household consumption, government consumption, investment, and exports) to each sector of output, where the coefficients of inputs and direct and indirect outputs are accounted for. It indicates the proportion of production factors used in the construction of the intercity highway project (Input Ratio). Bang Pa-in - Nakhon Ratchasima Line utilized or acquired from other production sectors for use in project construction; represents the output ratio of the intercity highway construction project. Bang Pa-in - Nakhon Ratchasima Line to another manufacturing division Multiplier in reverse is equal to the sum of the vertical inverse matrix (I-A). It is used to describe the influence of suppliers of products and raw materials on the construction supply chain. In addition, the sum in the horizontal row represents the forward multiplier (Forward), which indicates the extent of the impact on the downstream sector. can be examined from two perspectives:

4.2.2.1 Direct Coefficient

Based on the analysis of the coefficient of production factors and direct and indirect output (Direct and Indirect Coefficient) from the table of production factors and output (Input-Output Table) of Thailand, 2015, size 180 production sectors, it was determined that the Bang Pa-in - Nakhon Ratchasima intercity expressway project utilized the first 10 production sectors.

Quarrying and rock pulverizing involve the production of concrete-making raw materials such as rocks, soil, gravel, sand, clay, and rocks. Which is the primary material for road construction and has a coefficient of 0.1711, meaning that for every 1 baht of the expansion of the construction of the intercity highway project, the mining and quarrying sector will expand by 0.1711 baht.

Construction of concrete items It involves the manufacturing of concrete products such as concrete slabs, building supports, and concrete piles. constructing with concrete and reinforced concrete the coefficient for types of precast concrete and

prestressed concrete used in the construction of prefabricated buildings, including ready-mixed concrete, is 0.1511. This means that every 1 baht of the expansion of the construction of the intercity highway project will result in an increase of 0.1511 baht in the field of concrete product production.

Steel manufacturing of goods sector It involves the manufacture of galvanized steel sheets. Tinplate Hot-rolled steel plate, steel bar, steel wire, steel conduit, steel casting, and iron powder have a coefficient of 0.1428, which means that for every 1 baht of the expansion of the construction of the intercity highway project, the steel product sector will expand by 0.1428 baht.

cement manufacture It involves the manufacturing of Portland cement and blended cement. The coefficient for white cement and lime is 0.1171, which means that every 1 baht of the expansion of the intercity highway construction project will affect the expansion of the cement production sector worth 0.1171 baht.

Petroleum products are petroleum refineries composed of petroleum refineries. which produces gasoline, Engine oil, fuel oil, kerosene, diesel oil, and gasohol, has a coefficient of 0.1007, which indicates that every 1 baht of the expansion of the construction of the intercity highway project will affect the expansion of the petroleum refining branch, which is worth 0.1007 baht.

Production of petroleum and hydrocarbons It involves the extraction of crude oil and natural gas. It will affect the expansion of petroleum and natural gas production fields worth 0.0867 baht for every 1 baht invested in the expansion of the construction of the intercity highway project.

Other products derived from petroleum Consists of petroleum products including bitumen, motor oil, grease, carbon black, compressed coal, coke, and tar, among others. The coefficient is 0.0325, which indicates that for every 1 baht of the expansion of the construction of the intercity highway project, the expansion of other petroleum-based products will be affected by 0.0325 baht.

Moreover, the Bang Pa-in - Nakhon Ratchasima intercity highway construction project utilizes production factors from the service sector, specifically land

transportation. It comprises of truck-based land transportation services. To convey materials from manufacturers or suppliers to the construction site. With a coefficient of 0.0514, every 1 baht of the expansion of the construction of the intercity highway project will result in an increase of 0.0514 baht in land transportation.

commercial service It includes businesses that provide accounting services. Auditing, legal, engineering, architecture, technical, advertising, and the rental of apparatus are among the services offered. internet utility as well as business services directly related to construction projects that are not classified in other disciplines, such as accounting and auditing services of project contractors. Or in the portion of the Professional Engineer License has a coefficient of 0.0381, which means that every 1 baht of the expansion of the construction of the intercity highway project will affect the development of business services worth 0.0381 baht.

Electricity industry This sector encompasses the generation of electricity from diverse energy sources such as hydropower, fuel oil, natural gas, etc., as well as the transmission and distribution of electricity to residential consumers. Institution, business, commerce, and public affairs Including the power plant that the spinning industry itself has a coefficient of 0.0344, which means that every 1 baht of the expansion of the construction of the intercity highway project will result in a 0.0344 baht increase in electricity (Table 11).

Table 11 The direct coefficient of Top 10 production factors in the Bang Pa-in - Nakhon Ratchasima intercity motorway

Production Sector	Forward Multipliers	Backward Multipliers
The Bang Pa-in - Nakhon Ratchasima intercity motorway project	1.00	2.54
Agricultural	1.63	1.61
Mining	2.05	1.48
Manufacturing	2.01	1.90
Construction	1.04	2.26
Commercial	1.00	1.36
Service	1.56	1.82
Averages	1.47	1.85

Source: Calculations by a researcher

Forward Linkage Forward linkage occurs when an investment in the Bang Pa-in - Nakhon Ratchasima intercity motorway project results in the overall economic value being linked to intermediate or downstream industries as a multiple of the initial investment. The top five reasons why an increase of 1 baht in the production sector, in the case of investment in the expansion of the intercity highway project, can stimulate the economy are as follows:

1 . The production of petroleum oil and natural gas can stimulate the economy by 10,21 baht, which the production of petroleum oil and natural gas can do. The drilling of crude oil and natural gas are linked.

2. Petroleum refineries can stimulate the economy by 9.14 baht, which petroleum refineries can stimulate the economy by Link forward multiple branches, for example, this branch contains the gasoline-producing Petroleum Refinery. Engine oil, fuel oil, petroleum, diesel oil, gasohol

3.Financial institutions are capable of stimulating the overall economy by 5.47 baht; these financial institutions are linked to numerous branches because it is a business sector that supports and involves all production sectors.

4. Agriculture can stimulate the economy by 3.23 baht; agriculture includes glutinous rice and non-glutinous rice, as well as rice straw, which is linked to numerous industries such as flour production, the sector whose input is flour.

5.Construction of non-residential buildings can stimulate the economy by 1.25 baht, which construction of non-residential buildings can stimulate the economy by 1.25 baht. Numerous branches, such as factories, hotels, colleges, hospitals, and warehouses, are interconnected. Including building additions and maintenance.

Backward Linkage When there is an investment in the Bang Pa-in - Nakhon Ratchasima intercity motorway project that affects the production branch in the midst of the route or the origin and causes, this is referred to as a backward-linked branch. Enhanced total output value in the case of increasing sales (final demand), a 1 baht increase in products and services can increase the industry's total economic value. In the middle of the route or origin, the best five are as follows

1. Canned meat and other meat products have the potential to stimulate the economy by 2.66 baht; canned meat and other meat products are linked backwards. Production of pork, poultry, beef, buffalo, canned duck meat, and various forms of meat preservation, including ham, sausage, salted meat, chilled and frozen meat, etc.

2.The residential and non-residential construction industries Can stimulate the economy by a total of 2.51 baht through residential and non-residential construction. Multiple domains, including non-ferrous products, cement products, concrete, and forestry, are interconnected in reverse.

3. Pig farming at 2.45 baht can be added to the overall economy as a result of pig husbandry. interconnecting numerous branches Because it is raising hogs for slaughterhouse export for breeding purposes. and pork-based products

4. Land transportation can stimulate the economy by 2.42 baht, with land conveyance of goods connecting many manufacturing sector branches. Because it is a service sector that supports the manufacturing sector, which uses trucks to transport commodities.

5. Mining tungsten is the mining and processing of wolfram and sealite, linked reverse, such as steel products, which can stimulate the economy by 2.07 baht.

Furthermore, when analyzing the supply chain of the construction industry, which is the construction industry of public service construction unrelated to agriculture, it is necessary to consider the construction industry of public service construction. Including the building and maintenance of highways, roads, bridges, wharves, airports, and train stations, etc. The sources of employment from the state or government discovered that it was interconnected with numerous other industries. Beginning with the manufacturer of building materials. supplier of construction materials Construction firm Which is a construction material in terms of structural work, such as concrete, cement, iron and steel, and piles; system components, such as electrical system, water supply system, and communication system; and part of architectural decoration, such as glass, door, and window; and which is an upstream industrial group? It is also involved in midstream industries, such as the manufacturing of construction equipment. The production of industrial apparatus and electric tools for use in the real estate industry and numerous service sectors, such as land transportation financial institutions, restaurants, and hotels, etc.

4.2.3 Economic Impact Assessment in The Case of Bang Pa-in - Nakhon Ratchasima Intercity Motorway project

From the economic impact assessment of the Bang Pa-in - Nakhon Ratchasima Line intercity highway project the total value of the project is 64,380,958,3 million baht as a result of the addition of 40 construction contracts to the total project construction budget. Bang Pa-in - Nakhon Ratchasima Line Consequently, the aggregate output value increased by 0.319% compared to the baseline scenario. affecting employment, increasing employment by 0.293 percent or equivalent to 14,033,25 million baht compared to the country's total employment value of 44,368,03

million baht Similarly, when assessing the impact of projects that have been completed and for which the actual budget has been disbursed, the actual budget should be considered. The project has completed 24 of 40 contracts, with a total distance of 115,851 kilometers divided into 14 sections (Table 12).

Table 12 Completed projects for which the actual budget has been disbursed.

Order	Construction period	Disbursed allotment value (million baht)
1	กม.ที่ 0+000 - 7+332.494	1,815,576,000
2	กม.ที่ 0+000 - 4+525,5+100 - 9+008.350	1,981,700,000
3	กม.ที่ 9+008.350 - 15+000	1,926,299,000
4	กม.ที่ 15+000 - 27+500	1,965,269,000
5	กม.ที่ 47+600 - 53+000	1,040,600,000
6	กม.ที่ 53+000 - 65+300	1,936,700,000
7	กม.ที่ 65+300 - 70+085	1,320,773,600
8	กม.ที่ 77+000 - 82+500	1,760,610,000
9	กม.ที่ 82+500 - 86+000	1,850,470,000
10	กม.ที่ 86+000 - 98+347	1,447,900,000
11	กม.ที่ 102+000 - 110+900	1,640,854,400
12	กม.ที่ 110+900 - 119+000	1,240,462,000
13	กม.ที่ 175+100 - 188+800	1,388,630,000
14	กม.ที่ 188+800 - 195+943	1,994,000,000
Total		23,313,641,276

Source: Department of Highways (2022)

It proved, based on the expenditure of the project's budget, that the entire output value The aggregate number increased by 0.116 percent relative to the baseline scenario. or a value of 16,066,56 million baht, and affecting employment by 0.106

percent or a value of 5 ,0 8 1 ,7 2 million baht when compared to the total value of employment in the country (Table 13).

Table 13 Economic Impact Assessment in The Case of Bang Pa-in - Nakhon Ratchasima Intercity Motorway project

Production Sector	increased output value (million baht)
Stone Quarrying	3,987.96
Furniture and Fixtures Metal	3,522.83
Engines and Turbines	3,329.52
Cutlery and Hand Tools	2,730.65
Cement	2,348.21
Petroleum and Natural Gas	2,021.78
Road Freight Transport	1,197.46
Business Service	889.04
Electricity	801.65
Concrete and Cement Products	758.73
Change in Gross Domestic Product	16,066.56
Change in Total Wage	5,081.72

Source: Calculations by a researcher

Considering Table 1 5 's industry-by-industry rankings, the top ten industries with the greatest change in output volume are the first ten listed. When the intercity highway project was completed On the Bang Pa-in - Nakhon Ratchasima line, quarrying and limestone crushing are performed. The output value increased by 3 ,9 8 7 ,9 6 million Thai Baht. The production of metal-based furniture and fixtures increased by 3 ,5 2 2 .8 3 million baht. The manufacturing of engines and turbines. The

output value increased by 3,329.52 billion Thai Baht. General iron and steel implements and implement the value of production increased by 2,730.65 billion Thai baht. Cement manufactures the value of production increased by 2,348.21 million Thai baht. Production of petroleum hydrocarbons and natural gas the value of the product rose by 2,021,78 million Thai baht. The product's value rose by 1,197,46 million Thai baht. Commercial activities. The value of production increased by 889.04 million Thai Baht. Electricity The value of production increased by 801.65 million Thai baht. The manufacture of concrete products. The output value rose by 758.73 million Thai Baht It demonstrates that a single road infrastructure project can benefit the economy in terms of increased productivity and employment, as well as link the output of other industries.

4.2.4 An analysis of the economic expansion of the Bang Pa-in - Nakhon Ratchasima Line intercity motorway project area. In the case of Phra Nakhon Si Ayutthaya, Saraburi, and Nakhon Ratchasima provinces with images of nighttime lighting captured by satellite

A study of the expansion of the economy of the intercity motorway project region Bang Pa-in - Nakhon Ratchasima Line In the case of Ayutthaya, Saraburi, and Nakhon Ratchasima, satellite images of nighttime lights provide a comparative analysis of the growth of night lights before and after the construction of the intercity highway. Bang Pa-in - Nakhon Ratchasima Line
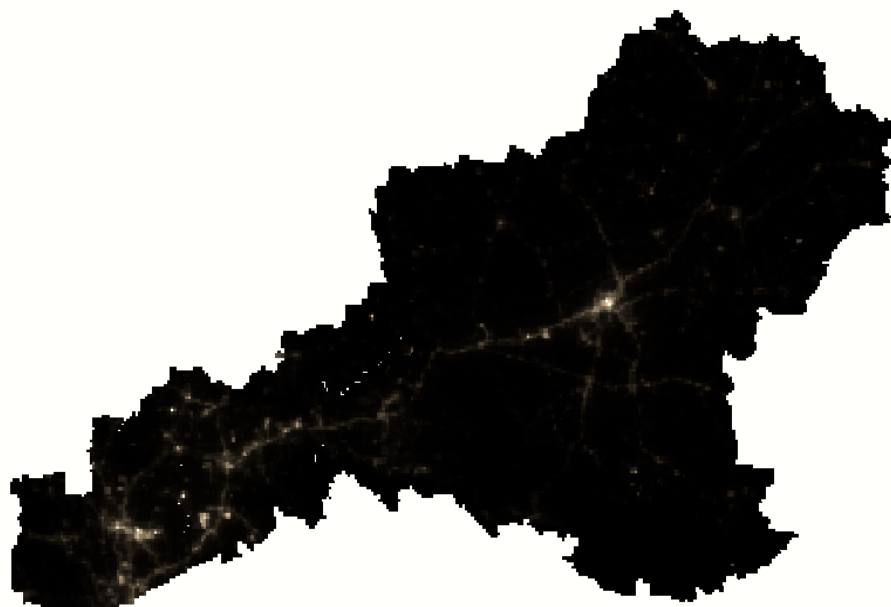
Figure 12 Night-time lights of Phra Nakhon Si Ayutthaya, Saraburi, and Nakhon
Ratchasima provinces in 2015

Source: Calculations by a researcher

Figure 13 Night-time lights of Phra Nakhon Si Ayutthaya, Saraburi, and Nakhon

Ratchasima provinces in 2022

Source: Calculations by a researcher

After the completion of the intercity highway project, the number of nighttime lights in Ayutthaya, Saraburi, and Nakhon Ratchasima decreased, as seen in Figures 13 and 14. The Bang Pa-in-Nakhon Ratchasima line, which will open in 2022, has a higher average night-time light (NTL) growth rate than in 2015, before the project began. The construction project areas in the aforementioned three provinces have increased urbanization. This is a consequence of the intercity highway project's infrastructure development. The Bang Pa-in - Nakhon Ratchasima Line is expanding every year. From 2015 to 2022, from the beginning of construction until the project is ready for testing.
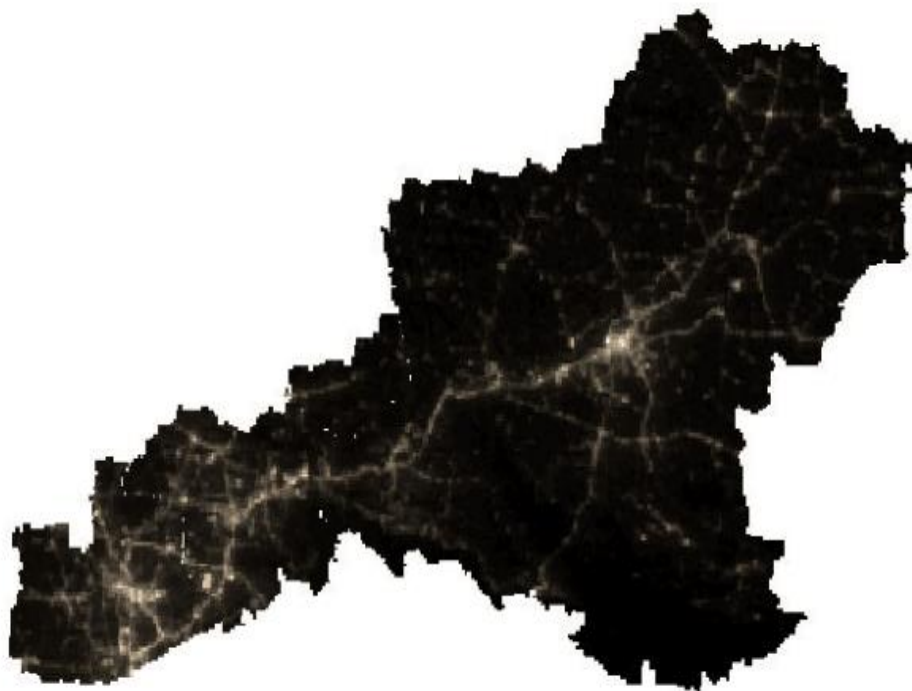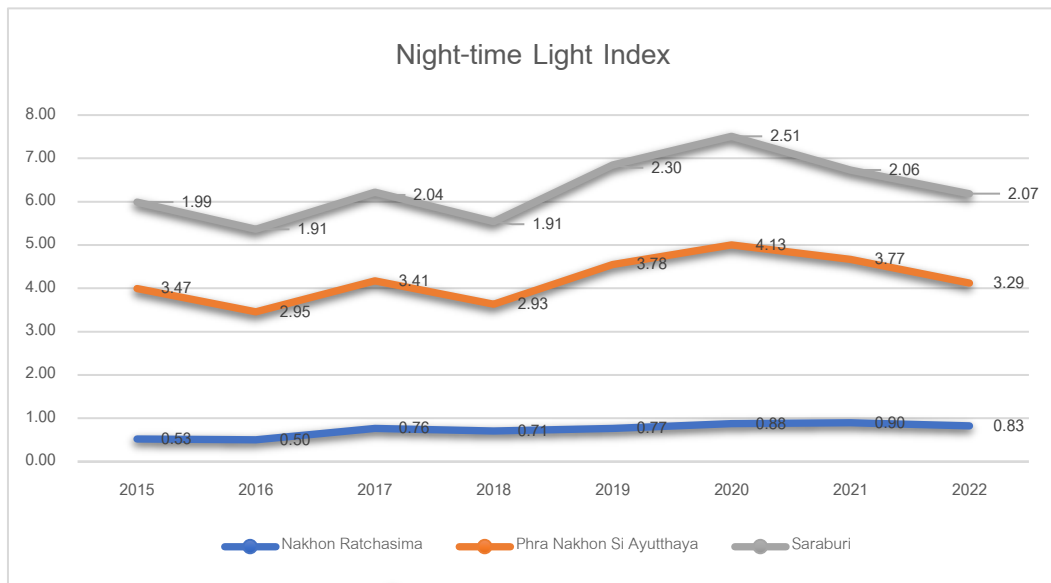
Figure 14 Shows the growth rate trend of night-time lights (NTL). of Phra Nakhon Si
Ayutthaya, Saraburi, and Nakhon Ratchasima provinces in 2022

Source: Calculations by a researcher

Figure 14 depicts the satellite data trajectory of the growth rate of night-time
lights (NTL) in Ayutthaya, Saraburi, and Nakhon Ratchasima provinces from 2015 to
2022. According to Duean, the Bang Pa-in - Nakhon Ratchasima Line is an intercity
highway initiative. Consequently, the economies of all three provinces are expanding.
Especially in the provinces of Saraburi and Nakhon Ratchasima. In Saraburi Province,
the night light index in 2022 was 2.07, an increase from 2015 when it was 1.99, and in
Nakhon Ratchasima Province, the index in 2015 was 0.53 and increased to 0.83 in Year
2022 due to the completion of the project, part of the contract, and the beginning of use
during the festival. whereas Phra Nakhon Si Ayutthaya province expands less frequently.
Since Phra Nakhon Si Ayutthaya Province has the motorway number 9 project and the
commencement of the intercity motorway project Bang Pa-in - Nakhon Ratchasima Line,
the province is a prime location for road construction. The construction is still in
progress.

An analysis of the relationship between socio-economic variables and
nightlight satellite data and economic progress in the project area.

The correlation coefficient between the night light index and the outputs of the three provinces in the Bang Pa-in - Nakhon Ratchasima intercity motorway project area, namely Phra Nakhon Si Ayutthaya, Saraburi, and Nakhon Ratchasima, was 0.888** and statistically significant. It indicates, at the.01 significance level, that the night light index and products from the three provinces group are positively related in the same direction. In addition, the correlation coefficient ranged from 0.81 to 1.00, indicating a high correlation (Best, 1997). will also result in increased product expansion, which will exhibit the same growth trend as shown in Figure 15.
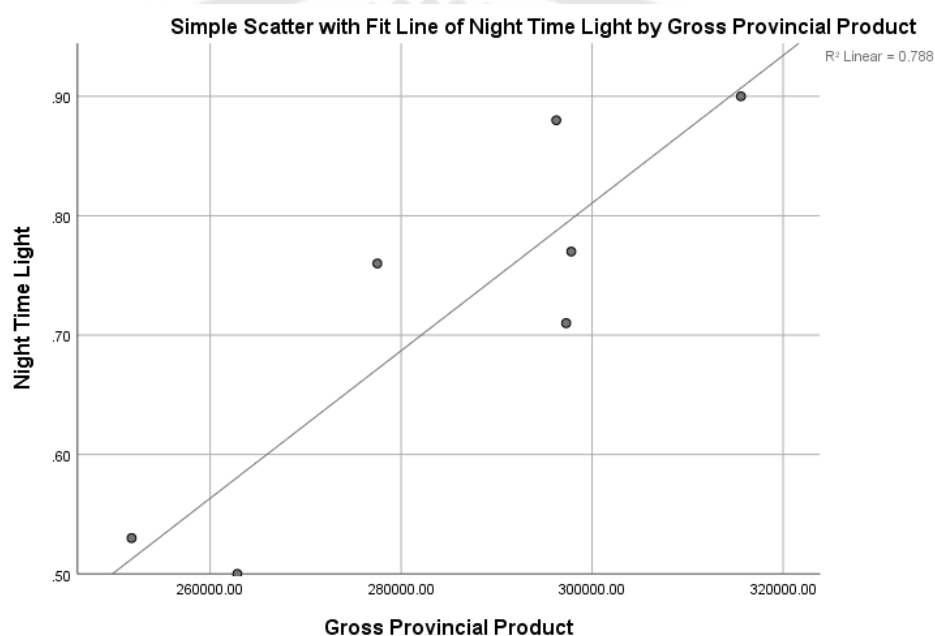
Figure 15 Shows the relationship trend of economic expansion and night-time lights of Phra Nakhon Si Ayutthaya, Saraburi, Nakhon Ratchasima provinces in 2015 – 2021.

Source: Calculations by a researcher

The economic expansion brought about by the intercity motorway initiative is depicted in Figure 16. From provincial product development and the night light index Prior to the intercity highway construction, the provincial output increased by 5.2%.

While the night light index rose by 0.74, this was a rise in the same direction. The Bang Pa-in - Nakhon Ratchasima intercity highway initiative has contributed to increased economic growth.

4.2.5 Evaluation of the Intercity Motorway Project Bang Pa-in - Nakhon Ratchasima Line's participants' impacts

Evaluation of the project's effects by those involved in the endeavor. The researcher conducted in-depth interviews with representatives from three groups of ten individuals. Department of Lands, Saraburi Province, Village Headman, Village No. 1 8 , Pak Chong Subdistrict, three professional surveyors Representatives from the private sector: Engineering Research and Development Manager, P.C.S. Machine Group Holding Public Company Limited; Production Manager - Equipment Production, Thai-Asia P.E. Pipe Company Limited; two individuals; and five representatives from the public sector or households. The data analysis was divided into the following two sections.

Issue 1 The findings of the construction process assessment for the Bang Pa-in - Nakhon Ratchasima Line Intercity Highway Project Key sources include: Chief Engineer, Department of Transportation Department of Lands, Saraburi Province, Village Headman, Moo 1 8 , Pak Chong Subdistrict, intercity highway project Bang Pa-in - Nakhon Ratchasima Line, professional surveyor. The plan includes a project to establish a special highway network between cities. For each intercity highway construction project, which was approved for operation by the Cabinet in 1997, numerous processes must be followed. There are numerous steps required to attain an intercity highway project. Following is the information acquired from the interviewers.

"In the construction of an intercity highway project, we must undergo a number of steps, beginning with the preparation of a detailed project plan and continuing with the presentation of a budget draft, route survey, and environmental impact analysis. economic return Construction design investigation of physical characteristics conduct public hearings to collect opinions from the public. Execute land confiscation by the Department of Lands. The construction of the Bang Pa-in-Nakhon Ratchasima Line intercity roadway project then began. The total distance is

approximately 196 kilometers, with the beginning location linking to Bangkok's outer ring road. Start at Bang Pa-In District Phra Nakhon Si Ayutthaya Province and terminate at the Nakhon Ratchasima bypass, divided into 40 contracts, with the following information on the construction process" (Professional Engineer, Department of Highways

1. process of route surveying prior to construction of the undertaking The Department of Highways must conduct an investigation of potential construction routes. How many routes exist, and which route offers the shortest distance? followed by an evaluation of environmental impact and economic returns To determine if investing in this endeavor is worthwhile.

2. Construction design procedure the design of bridges, highways, and rest areas, as well as toll gates, will be divided. It must also investigate the physical characteristics of the project's construction and its effects on the physical. Highway crossing Alternatively, the construction of an elevated bridge may obscure a number of vistas. Consequently, it is necessary to survey the area's physical characteristics.

3. The public hearing procedure Conduct a survey to determine whether or not stakeholders support the construction of the project. The objective is to enable as many people as possible to join. Collaborate with regional authorities.

"The purpose of the public hearing is to determine with the villagers where the expropriation will have the greatest impact, as it is where the villagers eat." The construction agency will make contact to schedule an appointment. Then, concerned villagers set a date for a public hearing. Beginning with the dissemination of information and clarification of particulars regarding the Bang Pa-in - Nakhon Ratchasima intercity highway project. Let the public comprehend initially Then allow the public to pose questions and voice their opinions in order to determine whether or not they support the project (village headman, Village No. 18, Pak Chong Subdistrict)"

4. The procedure of land expropriation by the Department of Lands When agreeing to compensation for landowners, they have approved. The Department of Lands surveys and seizes the property for future development

"Using confiscation of land, It is a procedure that occurs after the Department of Highways and the landowner have reached an agreement. Then, officials from the Department of Highways and landowners at the land office traveled to carry out the land expropriation simultaneously for the Bang Pa-in - Nakhon Ratchasima line of the intercity highway project. Ayutthaya, a distance of 24.5 kilometers, with approximately 500 plots of land to be expropriated, consisting of 200 buildings; Saraburi, a distance of 59 kilometers, with 1,500 plots of land to be expropriated, consisting of 300 buildings behind; and Nakhon Ratchasima Province, a distance of 59.5 kilometers, with 1,500 plots of land to be expropriated, consisting of 300 buildings behind. There are 1,200 expropriation areas, of which 570 are structures. As they are people's homes, the expropriation of buildings will be problematic. (Professional Land Surveyor, Department of Lands, Province of Saraburi)"

5. Construction method the construction was divided into two phases, Bang Pa-in to Pak Chong with six lanes and Pak Chong to Mueang Nakhon Ratchasima with four lanes and nine toll plazas.

For interrogating sources regarding the construction of the intercity motorway Bang Pa-in-Nakhon Ratchasima. The researcher can summarize the operation sequence as depicted in Figure 14.
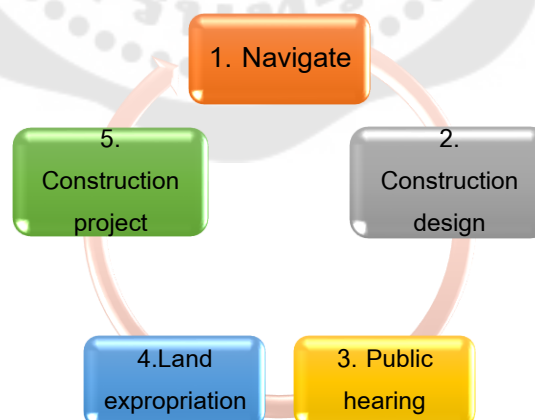

Figure 16 shows the construction process of the Bang Pa-in - Nakhon Ratchasima Intercity Motorway Project

Source: determined by the researcher

Issue 2 : The impact of the Bang Pa-in - Nakhon Ratchasima Line Intercity Motorway Project construction Representatives of government agencies, expert engineers, the Department of Highways, a professional surveyor from the Department of Lands in Saraburi Province, and the Village Headman of Village No. 1 8 , Tambon Pak Chong are among the key informants. The public sector representative and the private sector representatives are the Engineering Research and Development Manager of P.C.S. Machine Group Holding Public Company Limited and the Production Manager of Thai-Asia P.E. Pipe Company Limited.

"Before there were projects, the majority of land used for construction was referred to as vacant land, not residential areas. As a consequence of the Bang Pa-in - Korat special highway project, a new method of land utilization emerged. It is used to run a store. Because the journey is more convenient and the land's value has increased proportionately, a housing development is currently underway. Although there is some impact on the formerly residential area. And certain regions are divided by roads, making travel more difficult. In addition, the development of secondary road projects has increased as a result of the special highway projects. Therefore, it is considered that the advantages of a special highway project outweigh the disadvantages. (Professional Land Surveyor, Department of Lands, Province of Saraburi)"

Special Highway Project Bang Pa-in to Nakhon Ratchasima the objective of the construction is to reduce traffic congestion. Especially during holidays such as New Year's and Songkran, we wish to reduce the number of road accidents. Reduce travel time savings due to shorter distance traveled We also believe that the speed and travel duration for the 196-kilometer distance will depend on the driver. and desires economic expansion the initiative will facilitate travel between the central and northeastern regions. The economic expansion of the region increases investment. It also connects neighboring nations such as Laos, Vietnam, Cambodia, and Yunnan, China, and creates jobs. Clearly, the surrounding area and all five parking spaces, namely Wang Noi, Nong Khae, Thap Kwang, Lam Talay Long, and Kham Talay Sor, will generate trade, investment, and employment during the festival's free trial period. Can reduce Pak

Chong - Sikhio traffic by 344,717 vehicles, or 27 percent; Sikhio - Kham Thale So traffic by 222,234 vehicles, or 17 percent; and Pak Chong traffic by 209,118 vehicles, or 25 percent. Therefore, it is believed that the construction of a special highway is an economically and socially significant endeavor. (Professional Engineer, Highways Department)"

"The majority of our company's transportation consists of road haulage. Special highway initiatives will greatly facilitate the transport of goods. Due to the company's international exports, it is necessary to reduce travel time and connect to other modes of transport. Including the reduction of transportation expenses, we intend to increase production by facilitating transportation. Obviously, an increase in production will result in a rise in employment. If at all feasible, I would like the project to be completed so that it can be utilized on time and production can be better planned. consider the presence of an initiative to be advantageous to the company. Because prior to the company's transportation initiative, there was traffic congestion. notably throughout the bottleneck Shipping takes several days. (Director of Equipment Production, Thai-Asia P.E. Pipe Co., Ltd.)

"Intercity Motorway Project Bang Pa-in to Korat" Because the company is close to the project, this will facilitate the transportation of products to the company. Near the up-and-down checkpoint This decreases the time required to transport products. our expenses will be reduced proportionally. According to the project plan, if the project is completed on time, it will open for full service in 2025. will increase expenditure Plan the development of the production process and submit an application for additional employment Because the company manufactures auto parts. Exports and imports exist. Using road conveyance to connect to other modes of transportation. (Director of Engineering Research and Development, PCS Machine Group Holding Public Company Limited)

"The Bang Pa-in - Korat Motorway Project has caused the land value to increase, making the region more prosperous and travel-friendly." If the expressway

project is actually completed, the land value in the project area will undoubtedly increase. (Household in the project area)"

"The expressway project has an impact on our existence. When there is an undertaking, daily activities, including travel, are altered. The return journey is lengthier than the initial journey. making it challenging to waste time while commuting and a vehicle is traveling backwards, making the situation hazardous. Problems resulting from the environment the construction will feature a palisade. The greater the difficulty of travel on both sides. (Household in the project area)"
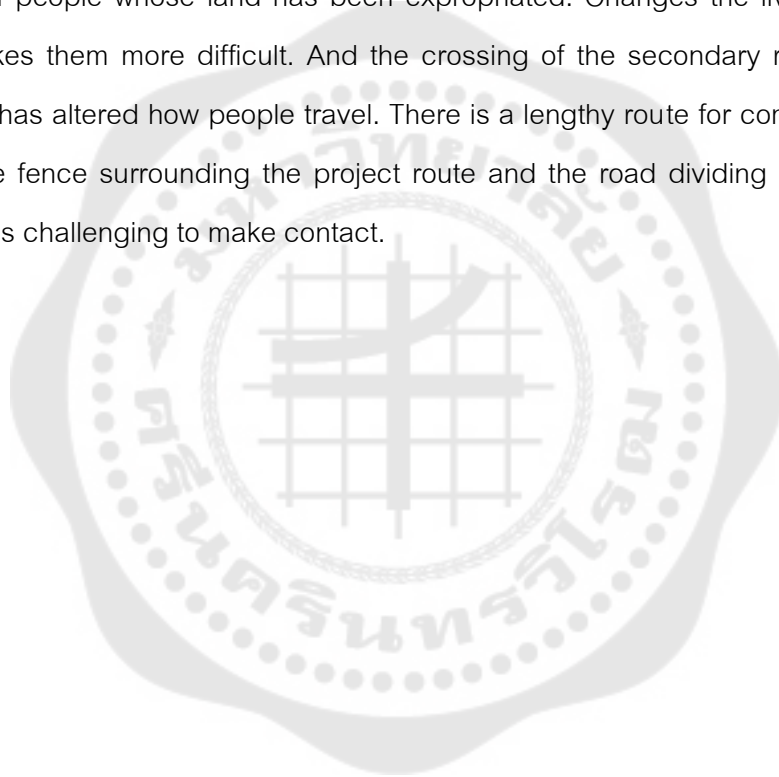
"Land confiscation for the development of residential projects." Insufficient expropriation compensation exists to cover the expense of relocating a farm. The problem of expropriation will not affect a person's ability to find a new residence if the construction of a project is accompanied by adequate compensation and the allocation of a new address. (Household in the project area)"

"Building a road through will improve business operations and facilitate traffic flow." There is a shopping halt. increase in client There is the inauguration of a new store. Add more stores, increase income, and increase travel Traveling to the city is easier than in the past. (Household in the project area)"

"I have evaluated the Bang Pa-in to Korat highway undertaking. The beginning of the season makes travel more convenient and expedient. Even during the festival, the vehicle is not trapped. Because during the festival on this route, during Saraburi, Pak Chong, and Korat, the vehicle is typically extremely stalled and nearly unable to move. However, it is advantageous to travel during the festival if there is a project. and increased investment the number of entrepreneurs who invest has increased. Land has always been costly. (Household in the project area)"

According to interview data the effect of the Intercity Motorway Project participants The Bang Pa-in - Nakhon Ratchasima line discovered that the project had favorable effects, namely the expansion of growth from the central region to the provincial regions. support foreign commerce and expand product market in neighboring nations The increase in employment also contributes to economic growth.

Create employment for the community's residents. Invest more to increase production as a result of improved and quicker transportation. There are connections to additional transportation options. Reduce the duration of both products' transportation and personal automobile travel. It can reduce the traffic problem by more than 20 percent, but it is only available during festival season. At the same time, it has a negative effect, namely the land expropriation issue that affects individuals who have lived and worked in that area for decades. The state may not have adequate compensation to satisfy the needs of people whose land has been expropriated. Changes the lives of individuals and makes them more difficult. And the crossing of the secondary road beneath the freeway has altered how people travel. There is a lengthy route for completing a U-turn. From the fence surrounding the project route and the road dividing the land into two sides, it is challenging to make contact.

Chapter 5
Conclusions Discussion and Suggestions

A case investigation of the Bang Pa-In - Nakhon Ratchasima intercity motorway project is included in research on economic impact analysis. The researcher studied and analyzed transportation infrastructure development plans in Germany, Sweden, Belgium, Austria, and Japan, as well as the intercity highway project's linkages and economic impact. Bang Pa-in - Nakhon Ratchasima Line and economic development analysis of the intercity highway project region Bang Pa-in - Nakhon Ratchasima Line In the case of Ayutthaya, Saraburi, and Nakhon Ratchasima, to evaluate the intercity highway project's impact. Bang Pa-in - Nakhon Ratchasima Line The investigation findings can be summed up as follows.

1. Conclusions

2. Discussion

3. Suggestions

5.1 Conclusions

5.1.1 Examine and compare the evolution of transportation infrastructure in Thailand and abroad. Germany, Sweden, Belgium, Austria, and Japan.

The transport infrastructure development strategies of Germany, Sweden, Belgium, Austria, and Japan. Thailand is also a significant trading partner for the country. The primary objective of each nation's transport development plan is to achieve sustainable development, such as economic growth. Focus on the environment and international competitiveness. Multimodal transport will be more efficient if an integrated, borderless transportation network is constructed. Balanced utilization of the logistics system for all products. However, continuous transport and each nation's logistics policy Not limited to simply modifying the mode of transportation. Nonetheless, the multimodal transport policy is also connected to measures that facilitate interconnections and cooperation.

- Effectiveness achieving global competitiveness and implementing the logistics of the supply chain via continuous transportation from origin to destination. (Door-to-door) efficiently. In Germany, there is a policy of investing in the essential maintenance of existing projects and in infrastructure replacement. It is an improvement and new construction initiative involving a network of roads, railroads, and waterways. Evaluate projects that have a significant impact over a large geographical area and that are useful and necessary for the economy as a whole in terms of increasing capacity or enhancing quality. To accommodate population expansion, a long-term plan has been established for Sweden's transportation system to develop high availability and transport facilities. The expansion of the metropolis and the advancement of the economy. Combined with increased global trade and prosperity. The government of Belgium has a transportation policy. To enable citizens to choose the most expedient mode of transportation each time they travel. In urban regions, the infrastructure is permanently congested with traffic. Improving transport efficacy in Austria prevents traffic congestion. Rerouting and optimizing the performance of each mode of transportation. create travel convenience Take shorter journeys on longer routes to avoid traffic and collisions. Develop modes of passenger and cargo transportation. Under the policy of the Japanese government, Japan has a plan for its transportation infrastructure. Prioritized by the government is the establishment of cooperation between the government sector and pertinent private agencies in order to comprehend government policy. fostering investment partnership between the public and private sectors Compared to Thailand, which seeks to develop the country's transportation, it was discovered that the city is expanding and the transportation network is not yet fully developed. The cost of logistics remains significant. In terms of policy, supervision, and cooperation between the public and private sectors, as well as a lack of integration with other government agencies, the roles and responsibilities of the accountable agencies are still ambiguous. Related And a significant factor in the development of transportation in Thailand is the problem of political instability and the government's ambiguous and continuous policy regarding the development of transportation infrastructure. Moreover,

the advantages of geographically central locations and routes through numerous routes contribute to the development of Thailand's transportation. The same nation as Germany. Thailand has land transportation connections with its neighbors. can be the region's transit hub.

      - Sustainable development through the improvement of the environment and society through the use of multimodal transport systems In Germany, the upgrading and reconstruction of road, rail, and waterway networks are concurrent. The investment strategy for transportation infrastructure seeks to reduce pollution. Bicycle route on road interchange and viaduct the expansion of two-lane federal highways to three-lane highways is one example of a transportation safety improvement plan. Construction of a roadway connection to the port to reduce the climate impact of transportation systems, Sweden has tightened emission reduction measures. Enhance social security and transportation Promote the transition of freight transportation from auto to rail. In addition to expanding the road network for 74-ton trucks, new high-speed rail primary transport lines are being extended to facilitate intercity connections. Belgium establishes secure parking and transportation, as well as measures to reduce noise and pollution, with consideration for the citizens' quality of life. Based on a paradigm of sustainable travel for both passenger and freight transport. Austria's 2030 master plan calls for a climate-neutral transportation sector by 2040. Encourage the use of battery electric vehicles for personal travel. In addition, public transportation will emphasize train travel to reduce energy consumption and air pollution. Similar to the country in Japan that prioritizes societal quality of life and environmental sustainability. Regarding Thailand's development of sustainability, it was discovered that the country's development policy was prepared to support sustainability. Thailand's road network encompasses numerous forms of connections. Including the connection between continuously expanding metropolitan areas and the region. There is a regional expansion of an intercity expressway construction project. Projects involving public trains for both urban and rural travelers. Despite budgetary constraints and economic structures distinct from those of Germany, Sweden, Belgium, Austria, and Japan. In addition, there is a

willingness to develop sustainability in terms of social development and multimodal transportation connections. However, Thailand continues to confront environmental issues. This is due to the fact that vehicular transport is the leading cause of air pollution and emissions controls are inadequate.

      - Innovation, the systematic use of advanced technology to facilitate and maintain transportation operations in accordance with international specifications. Sweden is one of the five most innovative countries in terms of logistics technology. investigation and development Transportation systems are becoming increasingly digitized and automated, and new technologies are reaching increasingly advanced levels of sophistication. Germany initiated the development of transportation technology and has a policy for intelligent public transportation. With a policy of self-driving cars that can operate on the road without drivers Includes small passenger and cargo transports. A Level 4 autonomous vehicle must be able to be controlled and turned down by humans at both short and long distances under the specified conditions. There is a policy in place in Belgium to develop intelligent transport systems (ITS) to facilitate the movement of people and products. There is a smart transportation infrastructure. Taking into account the quality of life of the people makes the transportation system more digital. The infrastructure linking traffic indicators to the central system has grown. Interfacing the detector with the central system Expansion of the camera network for the management of low emission zones Linking ANPR cameras utilized in restricted access zones There will be a policy to digitize transport in Austria, utilizing new technologies and mobility services in passenger transport that have the potential to transform automobile-dominated traffic into a new mode. Over short to medium distances, goods transport shifts from road transport to rail or waterway transport in order to promote the expansion of all public transport systems. Japan It emphasizes the use of technology and systematic database administration by employing Electronic Data Interchange (EDI), which not only helps standardize data but also facilitates data management. minimize mistakes Reduce work hours and management expenses. This ultimately leads to efficacy in the supply chain's logistics activities. Inasmuch as Thailand's innovation

development has led to the development of transportation that promotes equality or equality, this can be considered a positive development. Transportation is accessible to all, including the elderly and the disabled. Utilizing cutting-edge technology, including a centralized ticketing system, a navigation system (GPS Application), and intelligent traffic signs.

According to the policies, guidelines, and development of logistics infrastructure of global logistics leaders such as Germany, Sweden, Belgium, Austria, and Japan, the majority of the overall transportation infrastructure consists of both passenger and freight transportation. The predominant mode of conveyance will be road transport. To support population expansion, each nation will invest in the development of highly efficient road infrastructure. and economic expansion In the ever-changing realms of public transportation and cargo transport. Given that the road is a significant transportation network, it can be linked to other modes of transport. And the city's connection to the surrounding area as well. When the road is constructed properly. To reduce conveyance costs from road transport, the next policy will be the development of rail transport. Alongside the expansion of the port Reduce traffic problems, including accidental loss and congestion. Boost progress towards becoming a digital transportation system. Smart transportation reduces environmental issues and improves systemic transportation efficiency. Thailand's transportation system has also undergone continuous development. Despite this, Thailand's transportation system is still constrained by the inconsistency of freight transport in certain interregional connections. Focus the country's plan to develop its transport infrastructure on the development of road transport. The construction of highways to connect regions. Reduce travel time, and the development plan's secondary objective is the expansion of rail transport. and high-speed railroads because of constraints in terms of a distinct budget and economic structure than Germany, Sweden, Belgium, Austria, and Japan.

5.1.2 Analyze the economic impact of the Bang Pa-in - Nakhon Ratchasima intercity motorway project.

5.1.2.1 Analysis of the production structure of the Bang Pa-in - Nakhon Ratchasima Intercity Motorway Project

Production Structure of the Intercity Motorway Project Bang Pa-in - Nakhon Ratchasima line determined that the investment in the construction of the project employs intermediate production factors valued at 231,485,989 million baht, accounting for 69.83 percent of the total production cost. The production of concrete products is the country's primary intermediate production factor. Quarrying and rock pulverizing for steel manufacturing cement production and land conveyance as for the project's production distribution structure, it was determined that a structure existed to satisfy the final demand in terms of total investment expenditures. 331 496 889 million baht Total output owing to the construction of the Bang Pa-in - Nakhon Ratchasima Line intercity highway project It is an investment initiative for the development of the country involving the construction of public services.

5.1.2.2 Forward and Backward Multipliers of The Bang Pa-in – Nakhon Ratchasima intercity motorway project

5.1.2.2.1 Direct Coefficient

With regard to the direct coefficient of production factors (Direct Coefficient), the top 10 products used in the Bang Pa-in - Nakhon Ratchasima intercity highway project were quarrying and quarrying, the primary material in road construction, followed by the production of concrete products. sector of steel product production cement production Including the use of components derived from petroleum products, specifically petroleum refineries. Production of petroleum and natural gas, as well as the manufacture of other petroleum-based products. Moreover, the Bang Pa-in - Nakhon Ratchasima intercity highway construction project utilizes production factors from the service sector, specifically land transportation. To convey materials from manufacturers or suppliers to the construction site. and business services such as accounting and auditing of project contractors or in the Professional Engineer License and electrical branch

5.1.2.2.2 Forward and Backward Linkages

From the analysis of the impact of the Bang Pa-in - Nakhon Ratchasima intercity motorway project on other production sectors, it was determined that the backward multipliers of the intercity motorway project are greater than the value of the forward multipliers (Forward Multipliers), indicating that the Bang Pa-in - Nakhon Ratchasima intercity motorway project has a greater impact on the upstream sector. This is the final step in the production process. Close to being delivered to the consumer, the product is currently in the final stages of production. And the project's backward multipliers are still greater than the average backward multiplier across all industries. In addition, the intercity highway project's forward multipliers are lower than the average forward multiplier across all industries. It indicates that the expansion or increase in the construction of intercity highways will increase the demand or demand for intermediate products used as a factor in production.

5.1.2.3 Economic Impact Assessment in The Case of Bang Pa-in - Nakhon Ratchasima Intercity Motorway project

Beginning with the economic impact assessment of the Bang Pa-in - Nakhon Ratchasima Line intercity highway project Using the construction budgets of all 40 construction contracts, it was determined that the Bang Pa-in - Nakhon Ratchasima Line intercity highway project resulted in the highest output value. The aggregate figure increased by 0.319 percent compared to the base case, or by 44,368.03 million baht, and it affected employment by 0.293 percent, or by 14,033.25 million baht, when compared to the country's total employment value. Similarly, when assessing the impact of projects that have been completed and for which the actual budget has been disbursed, the actual budget should be considered. The project has completed 24 out of 40 contracts for a total distance of 115,851 kilometers, including all disbursed expenditures, resulting in an increase of 0.116 percent in gross product. base case or equivalent to 16,066,56 million baht and impacting employment by 0.106 percent or equivalent to 5,081,72 million baht when compared to the country's total employment value. The first ten industries whose output changed the most due to the intercity highway project were determined by industry. On the Bang Pa-in - Nakhon Ratchasima

line, quarrying and limestone crushing are performed. Mostly manufacturing of metal furniture and fixtures Fabrication of engines and turbines cutting equipment General iron and steel implements and implements cement manufacture Production of petroleum and natural gas and land conveyance Business services, electricity, concrete product production It demonstrates that a single road infrastructure project can benefit the economy in terms of increased productivity and employment, as well as link the output of other industries.

5.1.2.4 An analysis of the economic expansion of the Bang Pa-in - Nakhon Ratchasima Line intercity motorway project area. In the case of Phra Nakhon Si Ayutthaya, Saraburi, and Nakhon Ratchasima provinces with images of nighttime lighting captured by satellite

Comparative analysis of photos of night lights in Ayutthaya, Saraburi, and Nakhon Ratchasima provinces in 2015 and 2022 revealed that after the intercity motorway project The Bang Pa-in-Nakhon Ratchasima line, which will open in 2022, has a higher average growth rate of night-time lights (NTL) than in 2015, before the project began. These three provinces' construction project areas have increased urbanization. This is a consequence of the intercity highway project's infrastructure development. From 2015 to 2022, the Bang Pa-in - Nakhon Ratchasima Line will be operational, with the index of night lights and products in the three provinces having a positive correlation in the same direction from the commencement of construction until the project is open for trial.

5.1.2.5 Evaluation of the Intercity Motorway Project Bang Pa-in - Nakhon Ratchasima Line's participants' impacts

The effect of the Intercity Motorway Project participants The Bang Pa-in - Nakhon Ratchasima line discovered that the project had favorable effects, namely the expansion of growth from the central region to the provincial regions. support foreign commerce and expand product market in neighboring nations The increase in employment also contributes to economic growth. Create employment for the community's residents. Invest more to increase production as a result of improved and quicker transportation. There are connections to additional transportation options.

Reduce the duration of both products' transportation and personal automobile travel. It can reduce the traffic problem by more than 20 percent, but it is only available during festival season. At the same time, it has a negative effect, namely the land expropriation issue that affects individuals who have lived and worked in that area for decades. The state may not have adequate compensation to satisfy the needs of people whose land has been expropriated. Changes the lives of individuals and makes them more difficult. And the crossing of the secondary road beneath the freeway has altered how people travel. There is a lengthy route for completing a U-turn. From the fence surrounding the project route and the road dividing the land into two sides, it is challenging to make contact.

5.2 Discussion

5.2.1 Examine and compare the evolution of transportation infrastructure in Thailand and abroad. Germany, Sweden, Belgium, Austria, and Japan

The primary objective of the transport development strategies of Germany, Sweden, Belgium, Austria, and Japan is sustainable development, such as economic growth. Focus on environmental sustainability and global competitiveness. Transportation will play a crucial role in sustaining economic development. This is due to the fact that transportation is a necessary infrastructure for economic development (Raghuram & Babu, 2001). within the preceding policy structure Multimodal transport will be more efficient if an integrated, transnational transport network is constructed. multimodal transportation and supply chain logistics operations. Germany's development policy includes investments in the essential maintenance of existing projects and in infrastructure replacement. It is an improvement and new construction initiative involving a network of roads, railroads, and waterways. Increase advances in capacity or quality that are beneficial and necessary for the economy as a whole. Sweden has long-term intentions to increase transport accessibility to accommodate population growth. The expansion of the metropolis and the advancement of the economy. To facilitate its citizens, Belgium has a policy development plan. Fixing the infrastructure in high-traffic urban areas Improving transport efficacy in Austria prevents

traffic congestion. Rerouting and optimizing the performance of each mode of transportation. While Japan places a premium on fostering cooperation between the public sector and relevant private agencies in order to comprehend government policy, the United States does not. fostering investment partnership between the public and private sectors Compared to Thailand, which seeks to develop the country's transportation, it was discovered that the city is expanding and the transportation network is not yet fully developed. The cost of logistics remains significant. Still unclear are the duties and responsibilities of the responsible agencies. In terms of policy, oversight, and cooperation between the public and private sectors, as well as the lack of integration between other government agencies Related And a significant factor in the development of transportation in Thailand is the problem of political instability and the government's ambiguous and continuous policy regarding the development of transportation infrastructure. Moreover, the advantages of geographically central locations and routes through numerous routes contribute to the development of Thailand's transportation. The same nation as Germany. Thailand has land transportation connections with its neighbors. Consistent with G. Kostka and Anzinger's (2016) stated the technological factor economic in general, decisions cause time and cost overruns on large undertakings. Numerous of these factors help to explain certain infrastructure planning and management cases.

Moreover, sustainable development improves the environment and society. Improving the use of multimodal transport is one of the plan's primary objectives. pertaining to Thailand the road network has been expanded to accommodate numerous forms of connections. Including the connection between continuously expanding metropolitan areas and the region. There is a regional expansion of an intercity expressway construction project. Projects involving public trains for both urban and rural travelers. Despite budgetary constraints and economic structures distinct from those of Germany, Sweden, Belgium, Austria, and Japan. and innovation development strategies the systematic use of advanced technology to facilitate multimodal transportation operations conforms to international specifications. Among the five leading logistics

nations, technological innovation is prevalent. investigation and development Transportation systems are becoming increasingly digitized and automated, and new technologies are reaching increasingly advanced levels of sophistication. There is a policy for self-driving vehicles, or automobiles that can drive themselves on the road. Expansion of the camera network for the management of low emission zones Utilizing Electronic Data Interchange (EDI), which not only aids in the standardization of data management, but also facilitates data, places an emphasis on technology and database management. minimize mistakes Reduce work hours and management expenses. This ultimately leads to efficacy in the supply chain's logistics activities.

While as Thailand's innovation development has led to the development of transportation that promotes equality or equality, this can be considered a positive development. Transportation is accessible to all, including the elderly and the disabled. Utilizing cutting-edge technology, including a centralized ticketing system, a navigation system (GPS Application), and intelligent traffic signs However, it has long been plagued by traffic congestion and severe road accidents. Due to the fact that public transport networks in urban areas and between cities are not yet comprehensive and systematically linked, they are unable to satisfy the public's transportation needs adequately. Transporting goods and passengers on the transportation primary road at a rate that exceeds the road's current carrying capacity. In the past, budget allocations for road transport development focused on physical development (Route Development expanded traffic channels and road networks) as opposed to management and social development. (Educating create traffic discipline urban development control and legal supervision) causing the budget to be quite high and the problem to not be solved as effectively as it should be. Comparatively, problematic analysis of development suggests that infrastructure planning and management is impacted by the particular political or governmental and economic context in which decisions are made and implemented. Consistent with Hammes (2013) stated that performance-based planning considerations may be used to select initiatives for inclusion in a country's transport infrastructure plan. By evaluating the undertaking with the greatest benefit-to-cost ratio.

This endeavor should be included first in the plan. And should not engage in endeavors whose negative impact (costs) exceeds their profits (benefits). However, it has been incorporated into the plan for infrastructure development. Therefore, efficiency may not be the only factor in determining which infrastructure initiatives to include in a plan. However, political considerations also influence the decision to develop infrastructure initiatives.

5.2.2 Analyze the economic impact of the Bang Pa-in - Nakhon Ratchasima intercity motorway project

Analysis of the Intercity Motorway Project Bang Pa-in - Nakhon Ratchasima Line's production structure According to the findings of the study, project construction investment utilized the most intermediate production factors. And is a domestic intermediate production factor utilized in the construction of intercity highways. The Bang Pa-in - Nakhon Ratchasima line produces concrete goods. Quarrying and rock pulverizing for steel manufacturing Cement production land conveyance and the intercity highway project's production distribution structure The Bang Pa-in - Nakhon Ratchasima line discovered that a production distribution structure exists to satisfy the ultimate demand in terms of capital expenditures. due to the construction of the Bang Pa-in - Nakhon Ratchasima Line intercity highway project It is an investment initiative for the development of the nation through the construction of public services, similar to Varnavskii (2021) Assesses the structural evolution and stability of the Russian transport sector. It was discovered that the proportion of intermediate products and services in the transport sector's total output decreased. while the proportion of final commodities rises It demonstrates that transportation is a crucial industry in Russia. During the period 2000-2014, the Russian economy grew rapidly due to the expansion of the transport system in sectors such as land transport, warehousing, and transportation support activities, which influenced the development of yield during the same time frame.

Analysis of Backward and Forward Multipliers for Intercity Motorway Construction the Bang Pa-in - Nakhon Ratchasima line discovered that the backward multipliers of the intercity motorway project are greater than the value of the forward multipliers (Forward Multipliers), indicating that the Bang Pa-in - Nakhon Ratchasima

intercity motorway project has a greater transmission effect on industries in the upstream sector, such as the concrete product manufacturing industry. Quarrying and rock pulverizing for steel manufacturing cement manufacture land transportation of products Therefore, the Bang Pa-in - Nakhon Ratchasima intercity highway project is located at the conclusion of the production chain. Close to being delivered to the consumer, the product is currently in the final stages of production. Consistent with Bing Zhao, Nuo Wang and Yixuan Wang（2022）, which examined the function of various modes of transportation, was cited. It was discovered that the transportation industry in China's industrial chain is the weakest link. The results of the interindustry linkage model indicate that forward links are stronger than reverse links for road transport. This suggests that China's transportation industry is more of a consumer of inputs from upstream industries such as petroleum and coal than a supplier to the downstream industry, transportation services. A high proportion of domestic freight is financed and insured via road transport.

Evaluation of the economic impact of the Bang Pa-in-Nakhon Ratchasima Line Intercity Motorway Project By combining the budgets of all 4 0 construction contracts, it was determined that the Bang Pa-in - Nakhon Ratchasima Line intercity highway project had a construction budget of Consequently, the value of the gross domestic product (GDP) and employment increased. Considered by industry, the first ten industries whose production volume changed the most due to the project are quarrying and rock grinding Mostly manufacturing of metal furniture and fixtures Fabrication of engines and turbines cutting equipment General iron and steel implements and implements cement manufacture Production of petroleum and hydrocarbons land transport Business services, electricity, concrete product production In addition, the Bang Pa-in - Nakhon Ratchasima Line intercity highway project is currently under construction. It demonstrates that a single road infrastructure project can benefit the economy in terms of increased productivity and employment, as well as link the output of other industries. The construction of intercity highways or motorways has a significant impact on the economic, spatial, and social dimensions. People's

economic and social opportunities are affected by the equality in transportation provided by increased access. (Niemeier, 1997)

Analyses of nighttime light expansion before and after the completion of the endeavor. It was determined that the initiative led to economic growth in the project area. In the same direction, the night light index and products in the three provinces were positively correlated. by the effect of greater access to economic expansion. land use pattern and property values This reflects conflicting results regarding the type of transport infrastructure. type of property, study area, national development level, etc. (Elburz et al., 2 0 1 7), and the project has a positive impact, that is, it spreads growth from the central to the regional areas. support foreign commerce and expand product market in neighboring nations The increase in employment also contributes to economic growth. Create employment for the community's residents. Invest more to increase production as a result of improved and quicker transportation. There are connections to additional transportation options. Reduce the duration of both products' transportation and personal automobile travel. Reduce traffic congestion. The negative impact is the problem of expropriating land that was formerly a domicile and displacing longtime residents and workers. The state may not have adequate compensation to satisfy the needs of people whose land has been expropriated. Changes the lives of individuals and makes them more difficult. Consistent with Bing Zhao, Nuo Wang, and Yixuan Wang (2022) discovered that the transportation industry boosts employment. creates jobs through China's logistics Once investment policies are established and transportation projects are chosen, the government will be able to develop more efficiently, and transportation projects will generate more job opportunities. Understanding the economic contribution and development of numerous transport industries is essential. It can assist governments in formulating policies to promote the balanced and integrated development of transport modalities. The strongest mode of transportation is road transit. Therefore, road transport should be prioritized and problems should be resolved so as not to impede economic development. And it has the maximum number of

backlinks and the largest multiplier. This indicates that the capacity to promote output growth in the upstream sector is relatively robust.

5.3 Suggestions

This section is presented so that the results of this study may serve as a recommendation for the development of transport infrastructure policy planning. Particularly the intercity highway initiative, which includes policy recommendations. Suggestions for future research and research limitations are as follows:

Suggestions for Policy

1. A comparison of the transport infrastructure development plans of five prominent transport nations with Thailand revealed that the primary development plan is to increase transport efficiency and develop future economic and social sustainability. Including the role of innovation in the development of transportation, which moves in the same direction as other countries' development plans. However, budget constraints and political unpredictability were the primary factors that delayed success. resulting in inconsistent and delayed operation Consequently, the government should focus on budget allocation. Good planning for both the short and long term in construction so as to prevent political instability from causing the construction budget to increase and the conclusion of the project to not be completed on schedule. Otherwise, it may hinder economic growth. And the government should increase investment in the training of transport experts to examine the cost-benefit analysis, as well as formulate an investment policy plan and select the construction of an intercity highway project that has a positive impact on the economy and increases the value and productivity of the economy. Employment-generating projects that create opportunities to improve the quality of life for the populace. And it is a project that can connect city economic growth to regional development.

2. Analysis of the relationship between the Bang Pa-in - Nakhon Ratchasima intercity motorway project and other production sectors revealed that the project's backward multipliers are greater than the value of the forward multiplier (Forward Multipliers), indicating that the project has a greater transmission effect on industries in

the upstream sector, such as quarrying and quarrying. Mostly manufacturing of metal furniture and fixtures Fabrication of engines and turbines cutting equipment General iron and steel implements and implements cement manufacture Petroleum and natural gas production concrete product manufacturing Including service industries like land conveyance. Business services and utilities reflect the importance of the transportation sector in the industrial supply chain. Therefore, the government should be aware of the industries involved in the transport infrastructure's upstream and downstream industry chains. Plan and formulate policies to promote the development of industrial divisions vital to the economic growth of the nation. in addition to a comparative analysis of the connections between various sectors within the industrial chain. This enables the identification of important related sectors. The government should have an investment strategy for the growth of the mining and quarrying industry, as well as the furniture industry.

   3. The evaluation of the intercity motorway project's economic impact revealed that the project increased domestic output. more employment In addition, after the construction of the project and the opening of the trial, the night illumination in the project area has been expanded. prior to the undertaking The relationship between the night light index and the product group of three provinces was positive and in the same direction. This reflects the increasing economic development caused by the construction of intercity highways. Therefore, the public sector should recognize that the economic contribution and evolution of various transport industries can assist governments in formulating policies that promote and balance the integrated development of various modalities of transportation. And distinct measures should be taken based on the unique characteristics of each mode of transportation. Particularly the road conveyance that dominates the country. The government should prioritize road transport and seek solutions to problems that do not hinder economic growth. Increasing Product Development Therefore, when planning the construction of the intercity highway to connect the region, this factor must be considered. The government should consider the structure of the industrial sector in that region, such as the

production in the Phra Nakhon Si Ayutthaya Industrial zone. Numerous manufacturing industries are located in Saraburi Industrial zone and Nakhon Ratchasima Industrial zone.

4. In addition to the positive effects of the project on the distribution of growth from the center to the region, the project also influences the distribution of growth from the center to the region. support foreign commerce and expand product market in neighboring nations The increase in employment also contributes to economic growth. Create employment for the community's residents. Invest more to increase production as a result of improved and quicker transportation. There are connections to additional transportation options. Reduce the duration of both products' transportation and personal automobile travel. Reduce traffic congestion It also has a negative effect, namely the expropriation of land that was formerly a residence and the displacement of longtime residents and workers. The state may not have adequate compensation to satisfy the needs of people whose land has been expropriated. Changes the lives of individuals and makes them more difficult. Therefore, when implementing the construction of government initiatives, it is necessary to assess their negative effects. The devastation that will befall the people The evaluation must determine the value of the impact. And allocate a budget for compensation adequate to the impact received prior to the construction of the structure, such as compensation for land expropriation, residential or commercial forms. Or provide alternative housing for affected individuals. And the government should move forward with transportation reorganization and efficiency improvement. It facilitates the transition from road transport to rail and water transport for long-distance transportation. Promote the integration of diverse modes of transport and the development of multimodal transportation.

Suggestions for Future Research

More suggestions for studying the economic impact derived from the research examined for this project include: The Bang Pa-in - Nakhon Ratchasima intercity highway project is only one of thirteen intercity motorway routes, and its construction has not yet been completed. Upon completion of the undertaking, follow-up

research should be conducted. This will increase the clarity of the effect. And additional research should be conducted on alternative routes, such as the intercity highway initiative. Bang Yai-Kanchanaburi Line intercity highway construction Pattaya-Map Ta Phut route intercity highway construction Nakhon Pathom - Cha Am intercity highway construction Bang Pa-in - Nakhon Sawan intercity highway construction, etc. Each endeavor may have unique economic repercussions. Including complementary industries that may be distinct. In addition, the next study should utilize the current data table of production factors and outputs for the project under study. It will assist to clarify and improve the overall impact.

Limitations of Research

The research being conducted is a component of a budget-based study of the Bang Pa-in - Nakhon Ratchasima intercity motorway construction project. The Department of Highways has 40 contracts, some of which cannot be disclosed, limiting the amount of data available for this study. making a comprehensive analysis unfeasible. This could result in more varied policy recommendations. And it is a study that applies the Table of Production Inputs and Outputs for the year 2015, for which the data is out of date with respect to the construction project. Consequently, the results of the study cannot adequately reflect the overall impact of the initiative. As a consequence of period transitions, the economic structure has evolved.

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