



## CHAPTER 1

### Introduction

#### 1. Rational of Study

In the past several years, environmental friendly issues have become remarkable all over the world. Firms have begun to be responsible for their business operations being in harmony with the environment and local community. Several organizations have enhanced their competitiveness through improvements in their environmental performance in compliance with mounting environmental regulations. The commitment to reduce the impact to environment is a key factor for competitive scenarios while companies worldwide are continuously trying to develop new and innovative ways to enhance their global competitiveness. According to The World Economic Forum 2009: Supply Chain Decarbonization 2009 report addressed the total supply chain carbon footprint for logistics and transport emissions that the logistics and transportation activities contributed approximately 2,800 mega-tonnes or 5.5% of the 50,000 megatons of annual CO<sub>2</sub>e greenhouse gas emissions generated by all human activities annually, around 2,500 mega-tonnes CO<sub>2</sub> are total mobility emissions as presented in Figure 1. Road freight is a major element of this footprint, at around 57% of the total, with ocean freight some way behind at 17%.

Also, changes in atmospheric concentrations of greenhouse gases (GHGs) and aerosols, land cover and solar radiation alter the energy balance of the climate system. Global GHG emissions due to human activities grew since pre-industrial times, with an increase of 70% between 1970 and 2004. Carbon dioxide (CO<sub>2</sub>) is the most important anthropogenic GHG. Its annual emissions grew by about 80% between 1970 and 2004. The long-term trend of declining CO<sub>2</sub> emissions per unit of energy supplied reversed after 2000 as presented in Figure 2 (a).

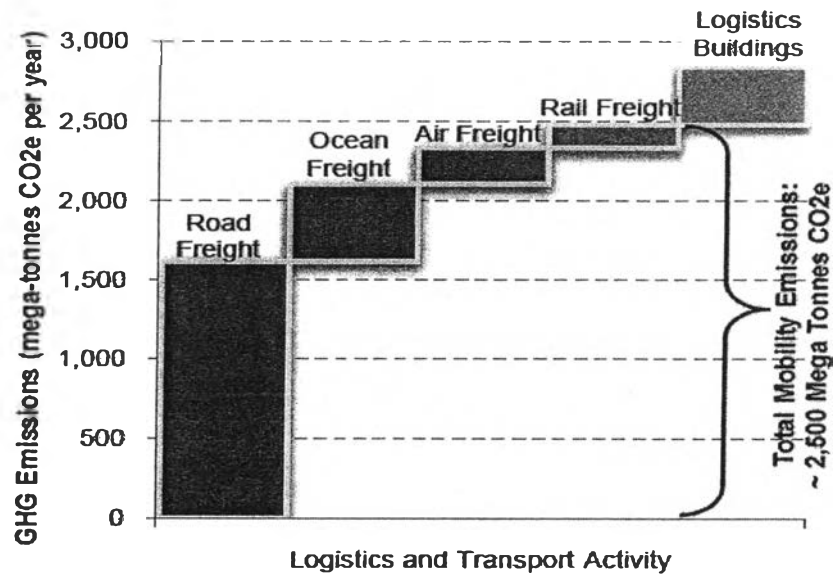


Figure 1: Emissions Share per Logistics Activity

Sources: The World Economic Forum 2009: Supply Chain Decarbonization 2009 report

Adding, global atmospheric concentrations of CO<sub>2</sub>, methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values determined from ice cores spanning many thousands of years. Global increase in CO<sub>2</sub> concentrations is due primarily to fossil fuel use, with land-use changes providing another significant but smaller contribution as presented in Figure 2 (b). It is very likely that the observed increase in CH<sub>4</sub> concentration is predominantly due to agriculture and fossil fuel use as Figure 2 (c). CH<sub>4</sub> growth rates have declined since the early 1990s, consistent with total emissions (sum of anthropogenic and natural sources) being nearly constant during this period. The increase in N<sub>2</sub>O concentration is primarily due to agriculture. There is very high confidence that the net effect of human activities since 1750 has been one of warming. Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic GHG concentrations.

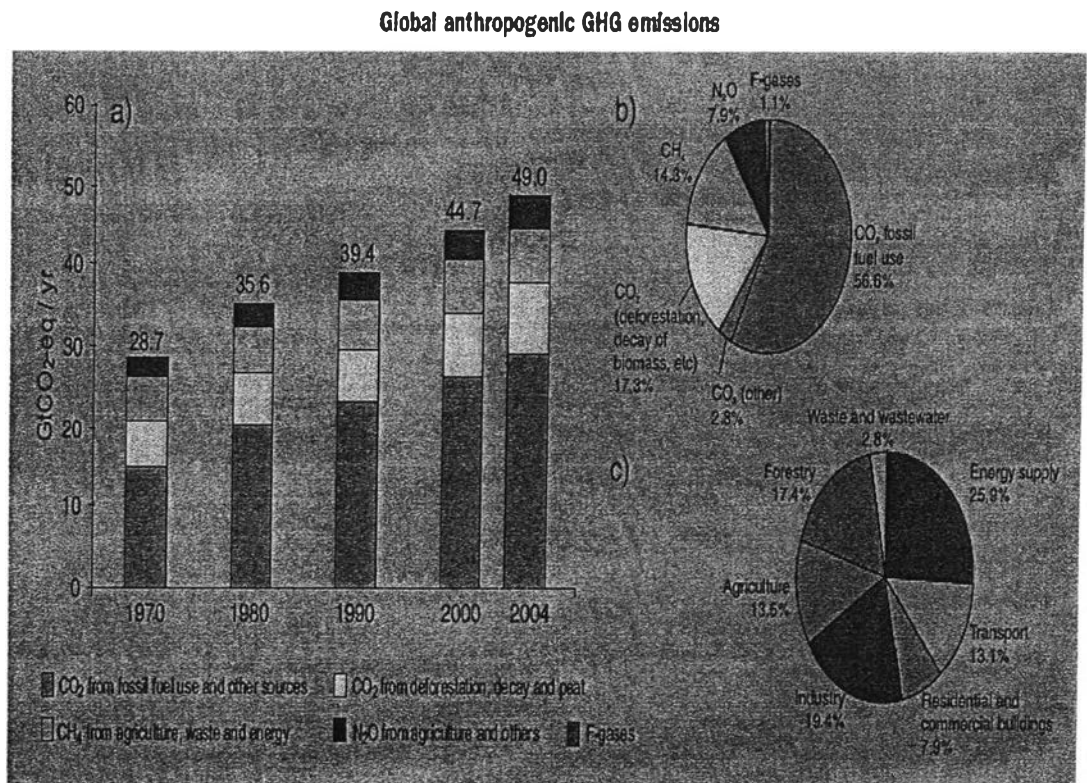


Figure 2: (a) Global annual emissions of anthropogenic GHGs from 1970 to 2004  
 (b) Share of different anthropogenic GHGs in total emissions in 2004 in terms of carbon dioxide equivalents (CO<sub>2</sub>-eq).  
 (c) Share of different sectors in total anthropogenic GHG emissions in 2004 in terms of CO<sub>2</sub>-eq. (Forestry includes deforestation.)

Sources: Climate Change 2007, Synthesis Report, Working Groups of the Intergovernmental Panel on Climate Change (IPCC), Spain, 12-17 November 2007

Other report of the International Energy Agency (IEA) presented the report of the world's CO<sub>2</sub> emissions in 2006 were 28 billion tons (gigaton, Gt), among which the transport sector was responsible for 23%, or 6.45 Gt. The United States and China issued two-fifths of the world's CO<sub>2</sub> emissions which presented in Figure 3. Thailand is the twenty fourth country in the 2006 world ranking generated and generated

CO2 emission for 245 Million metric tons of Carbon Dioxide, with a 44% increase from 1996.

World's CO2 Emissions by Sector in 2006 \*1 \*2      World's CO2 Emissions by Country in 2006 \*1 \*3 \*4

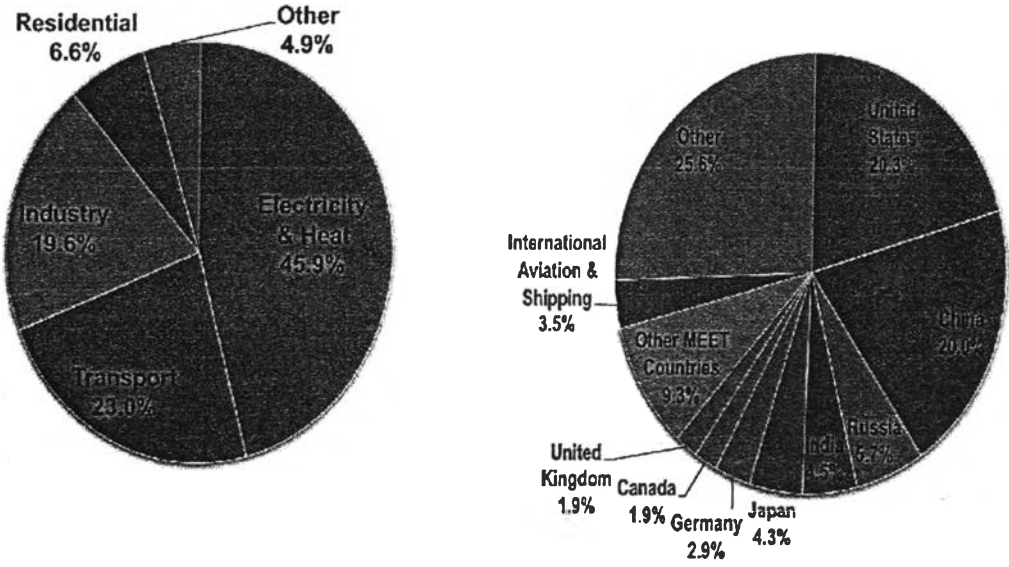


Figure 3: The world CO2 Emissions by sector and country in 2006

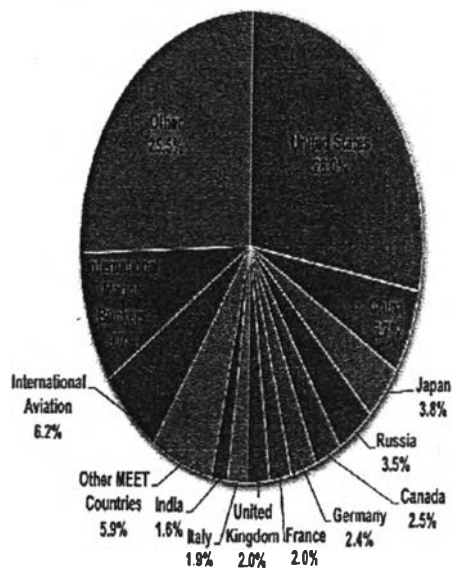
- \*1) CO2 emissions from fuel combustion.
- \*2) Emissions from international aviation and maritime shipping are included in the transport sector.
- \*3) Emissions from international aviation and maritime shipping are not allocated to each country.
- \*4) Emissions in Laos are included in "Other."

Source: International Energy Agency (IEA) (2008), CO2 Emissions from Fuel Combustion, 2008 Edition.

In Figure 4 showed that the sector which generated most CO2 Emissions in 2006 is the transport sector in the world emitted 6.45 Gt in 2006, among which the MEET participating countries were responsible for 54%, or 3.83 Gt. With emissions from international aviation and maritime shipping, the MEET Conference covers 69% of all

transport CO2 emissions. According to IEA estimates, the worldwide transport CO2 emissions will increase by 1.4 times to 8.9 Gt by 2030. Particularly, transport CO2 emissions from developing countries will double in the next two decades which makes it urgent to accelerate international efforts to achieve both economic development and environmental protection.

Transport CO2 Emissions by Country in 2006 \*1 \*2 \*3



Trends in Transport CO2 Emissions: 1980-2030 \*1 \*2

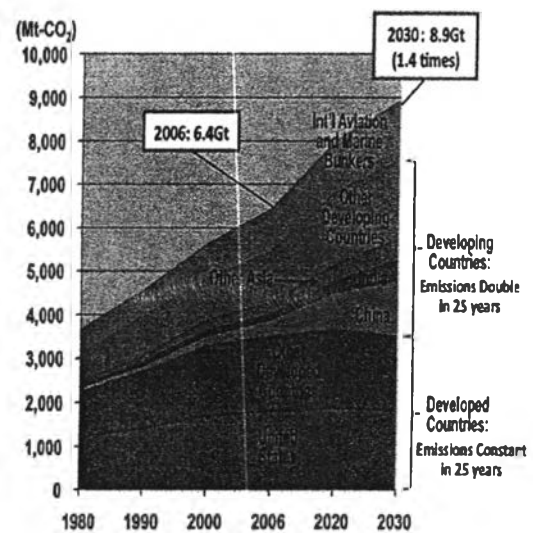


Figure 4: The world CO2 Emissions by sector and country in 2006

- \*1) CO2 emissions from fuel combustion.
- \*2) Emissions from international aviation and maritime shipping are not allocated to each country.
- \*3) Emissions in Laos are included in "Other."

Source: International Energy Agency (IEA) (2008), CO2 Emissions from Fuel Combustion, 2008 Edition; IEA (2008), World Energy Outlook 2008

From the above, it is evident; there is a need for creating a long-term sustainable society with the least possible negative environmental impact. In response

to this pressure, a new approach to logistics emerged in the early 1990's which went beyond the standard logistical imperatives for efficient, effective movement of goods.

This newly emerged approach takes into account measures for protecting the earth's environment: The green logistics approach. Logistics processes and activities have a significant effect in pollution emissions as one part in the Supply Chain Management (SCM). Therefore green supply chain and logistics have arisen in many industries and is a subject to recent researches.

In South East Asia, green concept is an initiative idea among ISO 14001 certified companies which has been realizing more to pursuit environmental sustainability in the supply chain or supply chain environment management (SCEM). Many organizations implement the concept together with their suppliers by cooperating as business partners with suppliers on green product designs, holding awareness seminars, and helping suppliers to establish their environmental program (Rao, 2002).

Moreover, the rewards present for corporate social responsible are hold as the recognition. The Nobel Peace Prize committee has turned its sights on the battle against climate change by giving the 2007 award to former US Vice President Al Gore and the Intergovernmental Panel on Climate Change (IPCC) to reward their efforts to build up and disseminate greater knowledge about man-made climate change, and to lay the foundations for the measures that are needed to counteract such change. (Lin and Ho, 2008). In their study staged that many firms realize the customers and other stakeholders do not always distinguish between a company and its suppliers (Bacallan, 2000). As a result, more and more companies have started to undertake significant efforts towards establishing green supply chain management (GSCM) initiatives (Srivastava, 2007; Zhu et al., 2008). The concept of GSCM encompasses environmental initiatives in inbound logistics, production, outbound logistics, and reverse logistics, including and involving materials suppliers, service contractors, vendors, distributors and end users working together to reduce or eliminate adverse environmental impacts of their activities (Beamon, 1999; Vachon and Klassen, 2006).

Researchers defined green concept in supply chain management from different perspectives and purpose for sustainable growth. They define green supply chain in term of green purchasing, total quality management (TQM), inbound logistics, productions, distributions, outbound logistics, marketing, customer focus, empowerment of employee, and well manage reverse logistics for cost saving and improved customer services. (Sarkis, 1995; Daugherty et al., 2001; Lin, 2007). Other perspectives are delivering products and services to customers more environmental friendly, logistics service providers need to address more efforts on environmental issues (Murphy and Poist, 2003).

In the study by Chen et al. (2006) "green innovation performance" is divided into two components in green innovation. The first one is "green product innovation", or the development of environmentally friendly products and services, including energy savings, pollution prevention, waste recycling, no toxicity or green product designs. The second component is "green process innovation" which focuses on the corporate management strategy. The result of their study showed that the performances of green product innovation and green process innovation were positively correlated to a competitive advantage for Taiwan Small and Medium Enterprise (SMEs) firms. Well-developed on green core competences, their green product innovation performance, green process innovation performance, and green image are increased and beneficial to the organizations. Also, the country's green image had a significant positive effect on the effectiveness of advertising, and reminded marketers about the importance of green image (Chan, 2000). Moreover, the study of Corrigan (1996) addressed that Irish export industries had significant growth, since Ireland promoted itself as a green European center of quality products and services, such that it had an advantage due to the green image. Therefore, the more industries and countries adapt the green management as core competency, the more positive influence their green products have on their green process performance, and green image. Moreover, companies which are pioneers in green innovations can benefit from the first mover

advantage and achieve high prices of their products and services, corporate reputation, competitive advantages, and sustainable growth.

The term of green marketing concept has become a tool for differentiating company positioning and has become a familiar buzz-phrase in recent years as organizations have targeted the environmentally conscious consumer and creative marketer and advertiser to develop a wide array of terms in order to describe the environmental impact and benefits of their products and services (Davis, 1991). The Green marketing practices are contributed by service providers through the 3R's which Reduce, Reuse or Recycle resources, are either collectively or individually and thereby embrace the green initiative (Grove et al., 1996). The authors addressed the "green marketing" The key challenge for green marketers will be more forward to strengthen individuals' perception of the individual benefits to be gained from going green by adding more and stronger emotional values to green brands, such as offering information on environmentally sound product attributes (Hartmann and Ibañez, 2006).

As international regulations and conventions on environmental protection become stricter and raise the environmental consciousness and customer are more willing to consume green products and even pay a premium for environment-friendly products (Chen et al., 2006; Berry and Rondinelli, 1998; Henriques and Sadorsky, 1996), which have a significant influence to businesses to pay more attention on corporate environmental management (Chen et al., 2006).

To adopt green supply chain management practices among firms also depend on their identification and assessment on the result of financial and operational benefits (Zhu et al., 2005). Moreover, the more firms realize the importance of green issues, the more likely firms push to their third party partners such as logistics (3PL) or other service providers to support them with green initiatives, or at least by exploring the possibility of doing so as their companies' transportation and logistics strategy (O'Reilly, 2007).



The companies adapt green innovation activities into a proactive strategy of the corporate environmental management not only prevents the company from facing environmentalist protests and penalties, but also helps businesses to develop new market opportunities, increase productivities, minimize cost, waste and improve the production, increase the corporate reputation and competitive advantage (Berry and Rondinelli, 1998; Chen et al., 2006; Henriques and Sadosky, 1999;). Furthermore, companies that proactively address environmental issue and social concerns can lead to a difficult-to-replicate competitive advantage and their suppliers toward future regulations (Carter and Dresner, 2001).

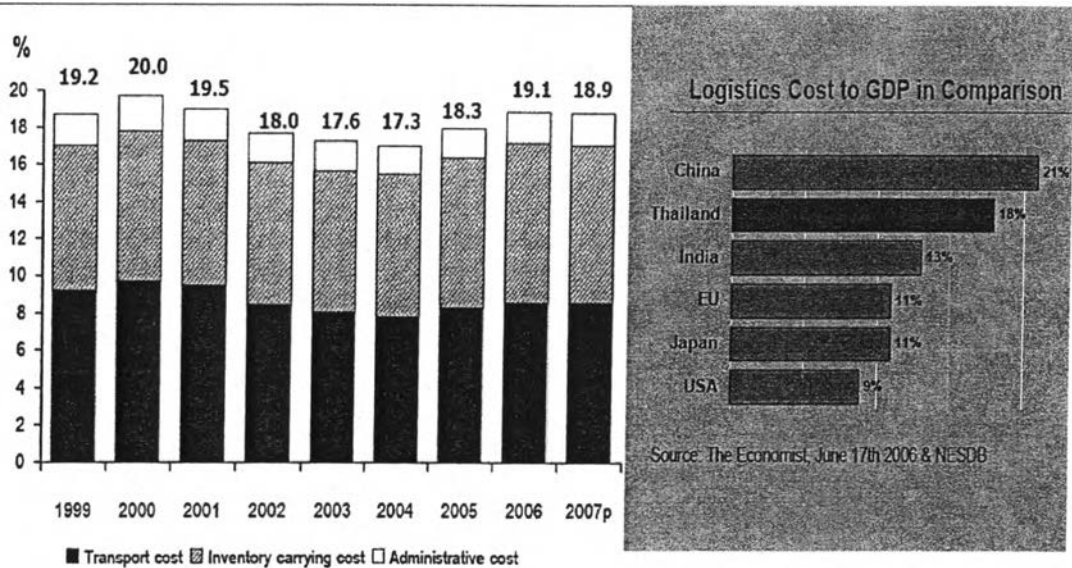
In South East Asia, like other developing regions, many organizations encourage green issues and the integration of environmental management considerations into their productions or operations and involve with products after use through reverse logistics. Also, environmental issues are encouraged by many firms in Thai industry.

### Thailand Logistics

The Office of the National Economic and Social Development Board (NESDB) stated in the Thailand's logistics report in the year 2007 for the first time that Thailand's Logistics Costs to GDP in 2007 is at 18.9% or THB1.60 trillion, which is relatively high as compared to most developed countries' (8-10% to GDP). There are transport cost of THB 736.2 billion (8.7% of GDP), inventory holding cost of THB 721.8 billion (8.5% of GDP) and logistics administration cost of THB145.8 billion (1.7% of GDP) presented in Figure 5 below.

Thailand's logistics costs were mainly consisted of inventory holding costs and transport costs. Both were relatively comparable in terms of value and proportions. However, by considering the average growth rate over the past decade, it is found that the inventory holding cost has been increasing at a rate of 8.9 % per annum, essentially higher than that of the transport costs (6.4 percent per annum).

**Thailand's Logistics Cost to GDP (1999-2007)**



Source: Thailand's Logistics Report 2008, NESDB

**Potential growth for logistics services is 3-4 times of GDP growth for the next 5 years.**

Figure 5: Thailand Logistics Cost to GDP

Source: an Office of the National Economic and Social Development Board (NESDB)

As a result, the first Logistics Development Strategy approved by the cabinet in 2007 has been put into implementation. It shows advances in many areas which focus on two objectives

- 1) To increase cost efficiency, customer responsiveness as well as reliability and security of in logistics services and
- 2) To increase economic values in logistics and supporting industries.

As in Figure 6, NESDB stated that Thailand's Logistics Development Strategy (2007-2011) has a vision to establish a world class logistics system at both national and industrial level in order to support Thailand as Indochina's trade and investment center with Two main objectives are 1) to increase cost efficiency, customer

responsiveness as well as reliability and security of in logistics services and 2) to increase economic values in logistics and supporting industries

5 strategies of Logistics Development have been formulated in a holistic view by covering

1. Logistics improvement for the real sector
2. Transport and logistics network optimization
3. Logistics service internationalization
4. Trade facilitation enhancement, and
5. Capacity building for the logistics sector (including database, human resource development, and driving mechanism)

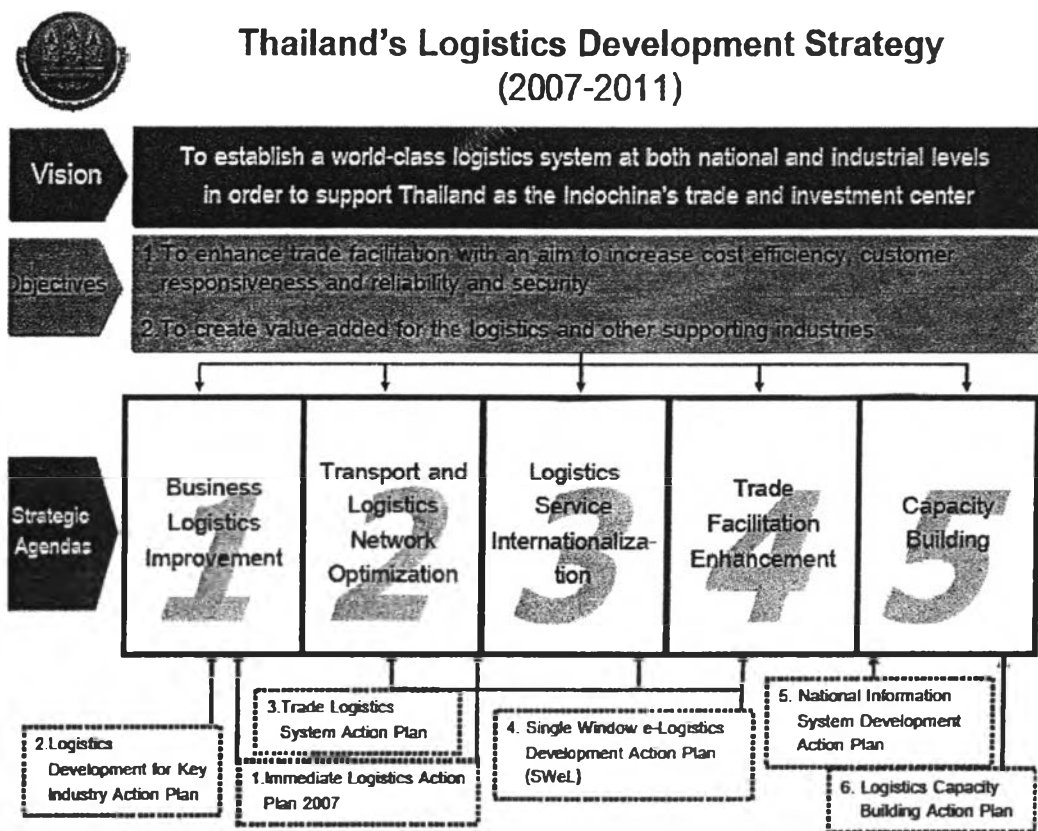


Figure 6: Thailand's Logistics Development Strategy

Source: Office of the National Economic and Social Development Board (NESDB)

In the study of Kamonchanok, (2007) about the current situation of logistics in Thailand stated that Thai logistics system is still in an early stage of development by government. Most logistics in the country is concentrated on physical distribution of goods and services. However, the government needs to take a more integrative approach to logistics management. The Government, therefore, is encouraging Thai companies particularly SMEs to invest in internally integrated logistics and externally integrated logistics. At the same time, the production and supply chain to the product distribution will need to be more efficient. There needs to be a networking system of different methods of transportation (road, rail, air, and sea). Furthermore, highways linking Thailand and other countries in the region will be crucial to promote intra-regional trade and investment. At present, the major problems and obstacles for logistics development in Thailand can be summarized as follows.

1. The concentration on only physical distribution
2. Lack of internally and externally integrated logistics
3. Lack of using IT for logistics
4. Few logistics business providers
5. Lack of connection between transport modes
6. Lack of rules and regulations

The Thai government, therefore, is now in the era of developing the strategies for Thai Logistics network and system. Several strategies have been launched. Many agencies concerned, both from the public and private sectors, are involved as such: Ministry of the Prime Minister, Ministry of Communications, Ministry of Industry, Ministry of Commerce, the Thai Chamber of Commerce, the Federation of the Thai Industry, and many professional associations concerning transport and logistics. Therefore, the improvement of logistics infrastructures will support the business to

reduce cost and gain competitive advantage but concerns less on applying green concepts in the overall strategy.

In Thailand, green strategy is being developed and implemented in certain industries including the automotive industry, transportation industry, textile and garment industry, and consumer supply chain industry. However, for some industries, green strategy is in its infant stage which includes pharmaceutical logistics service providers. The pharmaceutical logistics service providers supply chain system and logistics activities effect the environment while providing services to health care firms in Thailand. According to the Thailand Pharmaceuticals and Healthcare Report 2009 conducted by Business Monitor International Research Company addressed that the value of the Thai pharmaceutical market, estimated at THB116.11billion (US\$3.40bn) in 2008, is expected to top THB161.99billion (US\$5.59bn) in 2013.

Additional, the Bureau of Policy and Strategy, Ministry of Public Health published the Thailand Health Profile 2005-2007 report presented the drug consumption of Thai people accounted for approximately THB103,517 million in wholesale prices or THB 186,331 million in retail prices, or 42.8% of the overall national health expenditure (Table 1) in the year 2005. This proportion is rather high, compared with only 10% to 20% in developed countries (Figure 7). During the period 1988-2005, the rising rates of drug consumption exceeded the increasing rates of national health spending and economic growth. In general, an analysis of drug consumption patterns of Thai people revealed that about two-thirds of the consumption was done according to the decision or advice of professionals, such as doctors, pharmacists and other health personnel; the remainder was done as suggested by relatives, friends, or advertisements. As presented in Figure 7, the proportion of expenditure on drugs and health in Thailand is quite high according to the information of Thailand health profile 2005-2007 report presented that in a study about drug use in children with respiratory infections hospitalized nationwide revealed that 38.6% of the patients had ever taken antibiotics before coming to hospital. Other studies also indicated antibiotic use prior to visiting a

doctor or health official, particularly for cases with respiratory and gastrointestinal tract diseases. In most of the cases the drugs were used unnecessarily or inadequately. Also, due to advertising influence while very little effort was made to disseminate drug information to the public through various media including newspaper, radio, television and magazines. Although such efforts were made more intensively, most people got drug information from drug business operators. No matter through whom the people get medication, it is evident that irrational use and over-use of drugs, particularly antibiotics, are found at all levels.

During the past decades, health expenditures in Thailand were on a rapid upward trend, rising from THB 25,315 million in 1980 to THB 434,974 million in 2005 (Figure 8 and Table 2 in Appendix A ), a 17.2-fold increase. Per-capita health spending rose from THB 545 in 1980 to THB 6,994 in 2005 (Figure 9), a 12.8-fold increase in current prices. As a percentage of GDP, the national health expenditure rose from 3.8% in 1980 to 6.1% in 2005 (Figure 10), the growth rising at the rate faster than that for GDP, i.e. an average at 7.7% in real terms while the average GDP growth was only 5.7% annually (Table 3 in Appendix A). Most of health spending was on curative care as evidenced by the fact that the proportion of pharmaceutical spending rose to 42.8% of overall health spending in 2005 (Table 3 in Appendix A and Figure 10). As present in Table 4 and 5: the pharmaceutical consumption trend is growing even the economic is trend to slowdown. As the number of healthcare service providers have been established and expanded around the country, it affects to the cost of logistics activities cost.

Table 1: Value of locally produced and imported drugs (for human use) 1993-2005

Year	Wholesale values as reported (current prices)								Estimates of retail prices Country X 1.8	Estimates consumption values 2005		Change (%)		Total retail price value as a percentage of health expenditure	
	Values	Percent	Values	Percent	Total (million baht)	Values of exports (million baht)	Values of domestic consumption <sup>(1)</sup> (million baht)	Estimates values of domestic consumption <sup>(2)</sup> X 1.575		Wholesale price	Retail price	Current prices	Constant prices		
1993	3,777.9	65.2	2,012.0	34.8	5,789.9	255.8	5,534.3	9,270.0	18,668.0	20,131.02	38,298.01	-	-	40.52	
1994	5,453.0	76.5	1,673.0	23.5	7,126.0	284.0	6,842.0	11,460.4	20,628.7	24,703.42	44,466.31	+23.8	+22.7	39.49	
1995	6,851.2	73.5	2,393.1	26.5	9,244.3	315.5	8,928.8	14,620.7	28,317.3	30,741.58	55,334.85	+27.6	+24.4	44.41	
1996	4,878.0	71.5	1,884.5	28.5	6,542.5	350.5	6,192.0	10,371.8	18,668.9	21,405.22	38,529.39	-28.1	-30.4	28.28	
1997	5,145.8	68.9	2,325.4	31.1	7,471.2	389.4	7,081.8	11,862.0	21,351.6	23,904.75	43,028.58	+14.4	+11.7	28.73	
1998	6,708.8	72.3	2,571.0	27.7	9,279.8	432.7	8,847.1	14,818.9	26,674.0	28,748.65	51,747.57	+24.9	+20.3	29.65	
1999	8,372.9	71.7	3,307.8	28.3	11,680.5	480.6	11,199.7	18,759.5	33,763.1	34,550.72	62,181.30	+28.6	+20.2	32.13	
1990	8,888.0	72.0	3,448.1	28.0	12,335.1	604.1	11,731.0	19,849.4	35,368.9	34,157.80	61,483.68	+4.8	-1.1	28.23	
1991	9,857.8	68.8	4,216.4	30.4	13,874.0	784.6	13,089.2	21,924.4	39,483.9	38,045.22	64,881.39	+11.8	+5.5	28.43	
1992	10,898.8	68.6	4,682.6	30.4	15,378.2	1,193.5	14,185.7	23,761.0	42,763.8	37,537.81	67,568.06	+8.4	+4.1	27.06	
1993	11,831.0	70.0	5,075.3	30.0	16,906.3	2,055.3	14,051.0	21,535.4	42,363.7	35,870.63	64,747.14	-0.9	-4.2	23.02	
1994	12,969.7	68.1	6,088.6	31.9	19,058.3	1,536.2	17,520.1	29,348.2	52,823.2	42,698.87	76,657.61	+24.7	+18.7	26.41	
1995	15,820.9	63.0	8,276.4	37.0	25,097.3	2,398.5	22,698.8	38,020.5	68,438.9	52,287.18	84,116.88	+28.6	+22.5	30.06	
1996	18,120.4	62.9	10,676.0	37.1	28,796.4	1,784.9	27,011.5	45,244.3	81,439.7	58,777.14	105,798.88	+18.0	+12.4	31.63	
1997	19,608.0	58.3	13,487.1	40.7	33,075.1	2,319.7	30,755.4	51,515.3	92,727.5	63,413.50	114,144.30	+13.9	+7.9	32.88	
1998	18,127.7	53.3	14,146.5	48.7	30,274.2	2,782.3	27,491.9	46,048.9	82,888.1	52,426.80	94,367.88	-10.8	-17.9	30.02	
1999	19,033.9	57.2	14,232.3	42.8	33,266.2	3,014.9	30,251.3	50,870.9	91,207.7	57,508.74	103,515.72	+10.0	+9.7	32.09	
2000	20,995.9	55.7	16,700.4	44.3	37,696.3	3,732.7	33,963.6	58,889.0	102,400.2	63,574.15	114,433.40	+12.3	+10.5	34.18	
2001	23,067.9	53.6	19,867.8	46.4	43,055.5	4,328.9	38,726.6	64,870.4	116,768.7	71,342.74	128,416.89	+14.0	+12.2	36.35	
2002	24,144.8	54.9	19,867.8	45.1	44,012.5	4,115.5	38,897.0	68,827.5	120,289.5	72,898.48	131,397.31	+3.0	+2.3	36.04	
2003	26,588.1	50.5	26,024.9	49.5	52,611.0	4,821.5	47,789.5	80,047.4	144,085.3	85,891.53	154,604.75	+18.6	+17.7	38.92	
2004	31,707.8	50.8	30,545.5	49.1	62,253.1	4,961.8	57,291.3	95,963.3	172,734.0	100,234.49	180,422.08	+18.9	+18.7	43.97	
2005	29,704.8	43.7	38,293.4	56.3	67,998.2	6,186.9	61,811.3	103,517.4	186,330.6	103,517.13	186,330.83	+7.9	+3.3	42.64	
Source:	Drug Control Division, Food and Drug Administration, MoPH										Avg 18 yrs		12.8	8.5	-
	1. The estimates are to be deducted by export values														
	2. The reported figures are about 67.5% lower than actuality (48% underreported), and the reports do not include drugs from GPO, narcotics and psychoactive drugs														
	3. Retail prices are about 1.8 times of wholesale prices.														

Source: Thailand health profile 2005-2007 report, Bureau of Policy and Strategy, Ministry of Public Health.

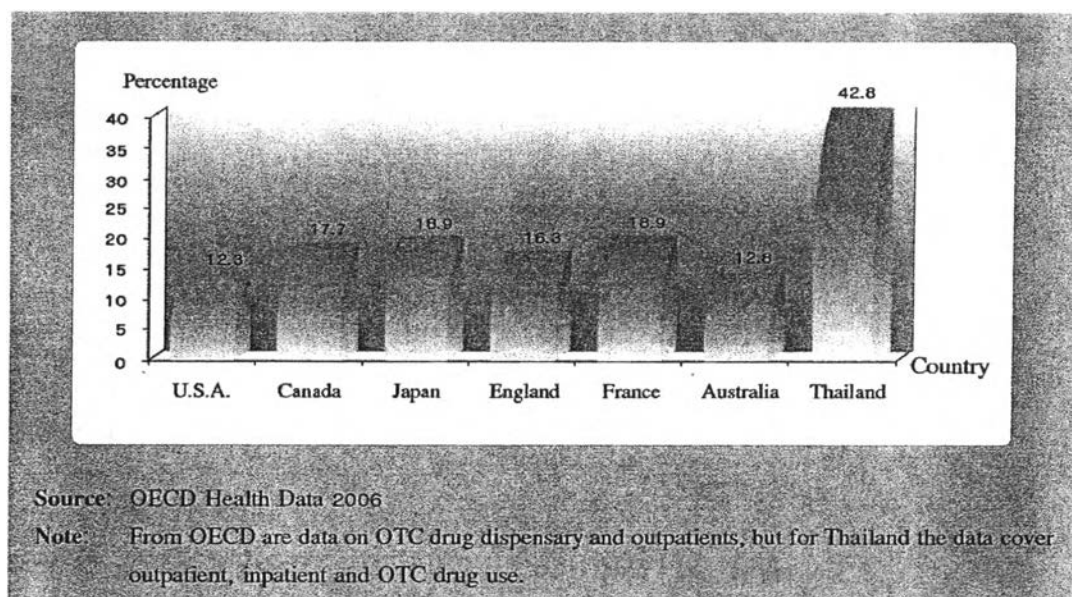


Figure 7: Proportion of expenditure on drugs and health in Thailand and other countries

Source: Thailand health profile 2005-2007 report, Bureau of Policy and Strategy, Ministry of Public Health.

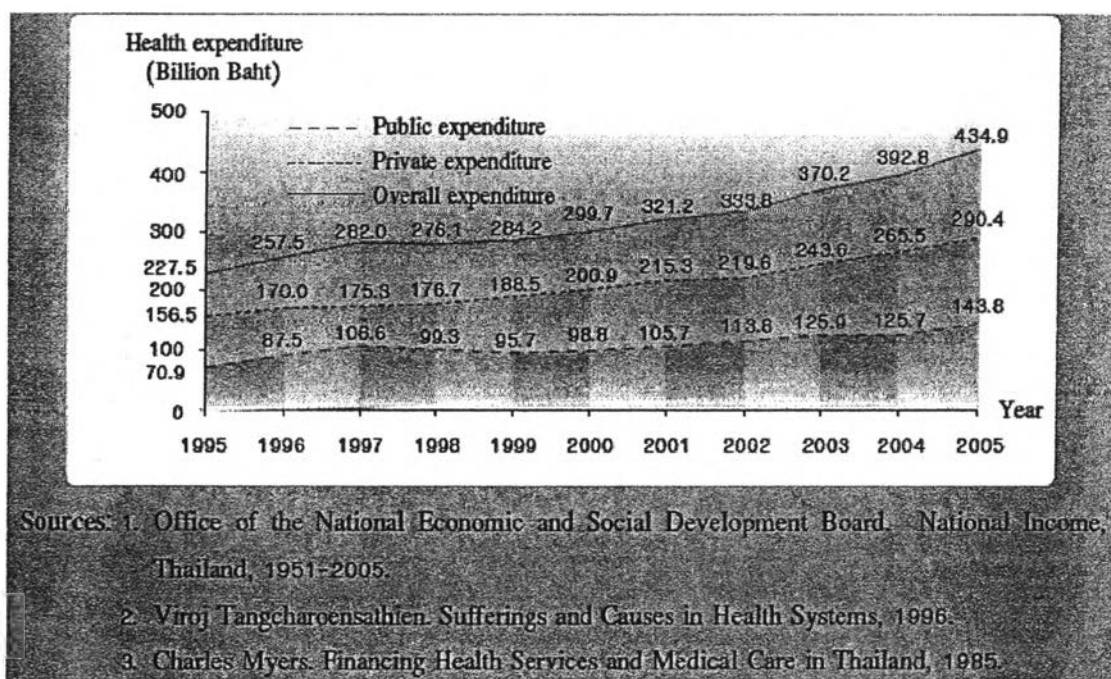


Figure 8: Overall public and private health expenditure in year 1995-2005

Source: Thailand health profile 2005-2007 report, Bureau of Policy and Strategy, Ministry of Public Health.



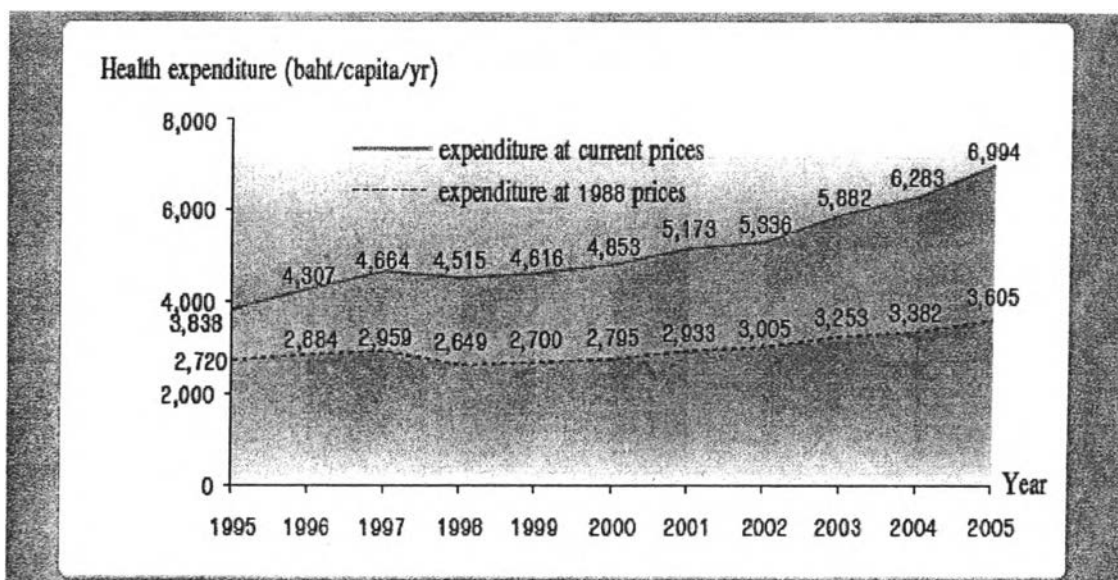


Figure 9: Overall health expenditure per capita at current prices and at 1988 prices, 1995-2005

Source: Thailand health profile 2005-2007 report, Bureau of Policy and Strategy, Ministry of Public Health.

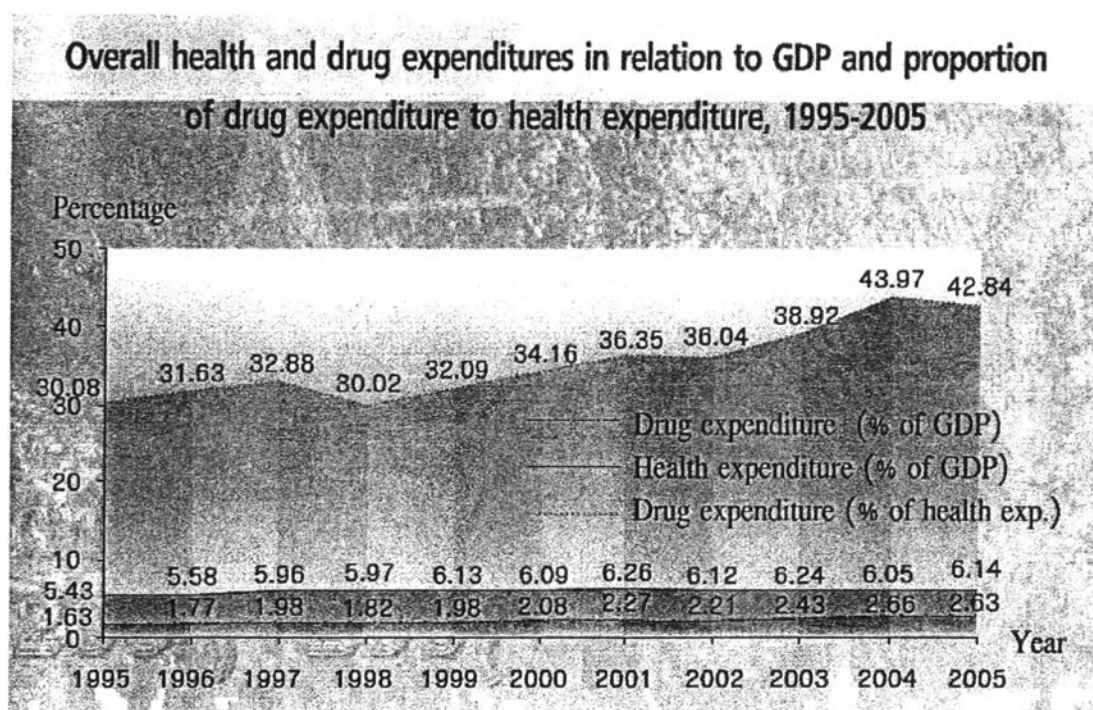


Figure 10: Overall of health and drug expenditures

Source: Thailand health profile 2005-2007 report, Bureau of Policy and Strategy, Ministry of Public Health.

Table 4: Drug distribution in Thailand: Percentage of drug values distributed through drug outlets

Type	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
	(Percent)	(Percent)	(Percent)	(Percent)	(Percent)	(Percent)	(Percent)	(Percent)	(Percent)	(Percent)	(Percent)	(Percent)	(Percent)
Drugstores	40	34	34	34	34	32	32	30	30	26	26	26	24
Public and private hospitals	43	46	52	52	52	58	58	60	60	64	64	64	66
Private clinics	10	15	9	9	9	7	7	8	8	9	9	9	8
GPO	2	2	2	2	2	7	7	8	8	9	9	9	8
Others	5	3	3	3	3	3	3	2	2	1	1	1	2

Source: IMS Company Thailand.

Source: Thailand health profile 2005-2007 report, Bureau of Policy and Strategy, Ministry of Public Health.

According to Tourism Authority of Thailand fact sheet, in the year 2007, there are approximately a total of 1,256 hospitals with 110,176 beds in Thailand, which include a total of 829 government hospitals with 74,562 beds under the Ministry of Public Health. And the rest is 336 private hospitals nationwide with 35,614 beds. As the Thailand health profile 2005-2007 report, health centers have been built and distributed to cover all sub districts (tambons) across the country since the last decade. In 2006, there were 9,762 health centers nationwide. The health centre to population ratio rising in the last decade had a rising trend in all regions of the country, from 1:10,064 in 1979 to 1:5,106 in 2006. Although health centers are mostly clustered in the Central Region, the regional disparities have actually decreased as shown Table 5. There are more than 15,000 drug stores and more than 16,000 clinics in year 2005, (Appendix A: Table 6, 7, 8, and 9). The distribution of drug outlets coverage are located over the country and the growth has shown an increasing trend in past decade. Therefore, the pharmaceutical service providers have to provide their services to cover all distribution channels to compete in the market. In better logistics performances without environmental

conscious, even the operations performance are improve but it will be increasing the impact to environment regarding more activities, more energy consumption, and more using resources, including paper, packaging and fuel consumption, especially the greenhouse gas emissions caused by transportation is also growing.

Table 5: Distribution of health centers by region in 1979 - 2006

Region	No. of health centres and health centre/population ratio										
	1979	1987	1996	1997	1998	1999	2000	2001	2002	2003	2006
Central	1,219 (17,781)	1,635 (14,729)	2,977 (13,654)	2,471 (13,554)	2,508 (14,298)	2,523 (14,219)	2,524 (13,681)	2,559 (14,628)	2,559 (14,811)	2,549 (14,629)	2,564 (15,179)
North	914 (10,748)	1,018 (11,775)	1,865 (14,412)	2,151 (14,103)	2,203 (14,363)	2,225 (14,345)	2,231 (14,283)	2,210 (14,167)	2,216 (14,870)	2,220 (14,862)	2,227 (14,739)
South	688 (8,230)	1,252 (13,621)	1,400 (13,136)	1,488 (13,653)	1,505 (13,694)	1,513 (13,822)	1,518 (13,672)	1,507 (14,127)	1,526 (14,418)	1,521 (14,453)	1,510 (14,763)
Northeast	1,277 (19,747)	2,489 (15,819)	3,100 (15,248)	3,367 (14,800)	3,398 (15,093)	3,428 (15,102)	3,433 (14,972)	3,462 (15,127)	3,509 (15,347)	3,475 (15,440)	3,481 (15,442)
Disparity between Central's and Northeast's ratios	1:1.64	1:1.23	1:1.34	1:1.36	1:1.18	1:1.21	1:1.21	1:1.17	1:1.17	1:1.18	1:1.05
<b>Total</b>	<b>4,098 (10,084)</b>	<b>6,992 (14,914)</b>	<b>8,842 (14,411)</b>	<b>9,477 (14,173)</b>	<b>9,614 (14,522)</b>	<b>9,689 (14,514)</b>	<b>9,704 (14,282)</b>	<b>9,758 (14,830)</b>	<b>9,810 (14,872)</b>	<b>9,765 (14,895)</b>	<b>9,762 (15,106)</b>

**Source:** The Bureau of Central Administration, Office of the Permanent Secretary, MoPH, recalculated by Rujira Taverat, Bureau of Policy and Strategy, MoPH.

**Notes:**

1. The figure in ( ) is the ratio of health centre to population outside municipal areas and sanitary districts.
2. Data on population outside municipal areas for 2001, 2002 and 2006 were derived from the Bureau of Registration Administration, Department of Provincial Administration, Ministry of Interior, and recalculated by Rujira Taverat, Bureau of Policy and Strategy, MoPH.
3. For 2003, data on population in 2002 outside municipal areas were derived from the Bureau of Registration Administration, Department of Provincial Administration.

Source: Thailand health profile 2005-2007 report, Bureau of Policy and Strategy, Ministry of Public Health.

As the above literature and secondary data, there are limited of research on pharmaceutical logistics service providers which create the big impact to the environment regarding to the increasing rate of drug consumption and health care service providers. The pharmaceutical supply chain in Thailand is complex and involves

multiple organizations that play different roles and some time overlap roles in drug distribution and contracting, including pharmacist at hospitals and drugstore, manufactures, distributors, wholesaler, and retailers which all of their activities create the impact to the environmental. This paper focus to explore and observe the current operations and logistics activities of a leading pharmaceutical distributor, which is the key player in supply chain system and create an impact to environment.

According to the Thailand Pharmaceuticals and Healthcare Report 2009 presented the market value in year 2008, estimated at THB 116.1 billion and is expected to THB 161.99 billion in 2013. With the distribution of healthcare service providers coverage are located over the regions of Thailand more than 43,000 places base on the data of Thailand health profile 2005-2007 by the Ministry of Public Health (Table 6, 7, 8, and 9), including public and private hospitals, health centers, drug stores, and clinics. The distribution of health centers was increased from 4,088 outlets, in year 1979 to 9,762 outlets in 2006, which is increasing by 138.80% and drug stores were increased from 12,125 drugstores in year 1979 to 15,425 drugstores in year 2006 which is increasing by 27.22%. The growth of industry implies that more operations and logistics activities will be occurred, it will impact to environmental in both direct and indirect ways. As the pharmaceutical industry trend has been increasing and the pharmaceutical distributor is the key player among the channel intermediaries with both drug manufacturers and end-user.

Therefore, this study aimed to study and explore the proper model, applying strategy and addressed the green logistics activities that might be possible to improve the environmental performances of pharmaceutical service providers.

#### **Applying Lean principles and tailored logistics strategy in the services sectors.**

There are various theories and strategies of logistics addressed in production and manufacturing industries. Simultaneously, in Japan, Just-In-Time (JIT) productions with the goal to reduce all waste from manufacturing and inventory and add

value for the customer. There are several activities for the firms to monitor, including waste times, inflated inventories, unneeded people or material movements, unnecessary processing steps, and any other non-value adding activity. As JIT is the backbone of the lean manufacturing system and initiate by Toyota in their production system which lean manufacturing have been derived from JIT. Lean Manufacturing defined as the organizing overall business processes to deliver products with greater variety and superior quality using less resource and in a shorter time than mass production methods (Jina, Bhattacharya K., and Walton D., 1997) and the philosophy has been applied in many businesses. One example includes the application of lean principles in high variety, low volume (HVLV) segment, improving the supplier selection and evaluation for manufacturing companies for increasing the purchasing performance efficiency (Barla, 2003), remarkable lean supply of the best practices for environmental identify in automotive industry (Lamming, 1996).

Apart from the lean concept success in manufacturing and production, a lean approach in pure service environmental is very limited (Bowen and Youngdahl, 1998; Abdi et al., 2006; Piercy and Rich 2009). Healthcare services provider apply lean thinking with flow models to liberate existing resources and allocate them for further improvements (Kollberg, Dahlgaard J. and Brehmer, 2007). Successful lean principal's cases of education institutions come from the top leadership that focuses on cost reduction or budget containment initiatives, waste reduction, improved operational efficiencies contribute to sustainability (Comm and Mathaisel, 2005). As lean adoption in service, suitability of basic lean methodologies such as value understanding, process mapping and problem solving significant improve the service quality of call center service providers (Piercy and Rich, 2009). Global retail supply chains adopt lean tools to improve the efficient consumer response (LCR), which brings supply partners closer together to reduce stocks throughout the retail supply chain, from the store to the origin manufacturer (Lamming, 1996), reduced holding stock cost, reduced write-off costs on perishable items and an increased ability to provide product available based on unpredictable customer demand (Jones and Clarke, 2002; Fernie and McKinnon, 2003;

Abernathy et al., 2000). As above literature review, presently there is limited research for applying lean concepts in pharmaceutical distributions.

### Tailored Logistics strategy

Furthermore on adopting green innovation concept as a company strategy, the logistics companies attempt to serve each customer requirement, who value the product and service in different ways and different in individual perceptions by offering and creating value for customers into the products and services in distinct ways. The concept of "tailored logistics" has been developed to emphasize the integration of logistics services with the core product in order to give each customer a value added product which has been tailor made according to his or her requirement (Fuller, O'Conor, and Rawlinson, 1993). Thus the companies can tailor logistics systems as a key strategy for differentiator, competitive advantage, cost saving and more profitable through the logistics channel of manufacturing transportation, warehousing, order handling, and control through products and service flow.

This paper will analyze the existing concepts of green innovations and green strategies collaborated with lean principles that are very effective in the manufacturing environment and apply the concepts to a pharmaceutical service provider environment. A concept model will be developed and tested in theory to gain knowledge concerning potential costs reductions and improved environmental impact to a pharmaceutical distributor.

The research will study the pharmaceutical logistics and supply chains, including operational process, logistics process, distribution process, internal / external factors that relate to green innovation and tailored logistics concept will be applied to a leading pharmaceutical logistics service provider case study which is facing a hostile market situation. The inventory management and inbound activities in the warehouse are out of scope since research materials already exist in that field.

The current operations of pharmaceutical distributor start from order processing, which is the first step of logistics process, including order transactions, paper using, time, energy, and all the error creating processes and the impact to the environment. Also, the distribution process, including delivery is one of the major costs to the company and energy consumption, time consuming, and distribution business line was the highest carbon emission.

The order processing starts with the receipt of an order from a customer and from many sources, including paper via fax, mail, telephone in, and via electronically software. It is an everyday task that order people have performed hundreds of times. Regularly, the first step in most order processing is to verify the accuracy of the order to ensure that the document contains no internal errors such as customer name, address for billing and shipping, product name, code, price, quantity, bonus, and special promotion. The data checking and issuing orders are performed by human who could create mistakes. The order processing speed and errors can be detected in data depend on the working experience and individuals skills.

The next step is to determining the inventory stock for shipping the goods, and then verifies the customer's credit or ability to pay. The orders with instructions are sent to a warehouse to process the orders. At the warehouse an "order picking list" is given to a warehouse staff, which assembles the specific order. In the packing area, it is checked and packed for shipment, and the package is labeled. The dispatch staff prepares the transportation documents and notifies a carrier to pick up the shipment. An invoice for the goods is sent to customer which all various inventory and financial records are updated. In addition, managing and improving the order cycle time which is a period between placing one set of orders and the next, is more demanding by customer to evaluate the logistics service provider's performance. Reducing order to delivery cycle time is an important issue in supply chain management and hard to control. This paper will propose strategy, tailoring activities, and enhancing fit, such as quality improvement, cost effective and lead time reductions.

Beside, the distribution processes, especially the delivery transaction, create big impact on the environment. The proposed strategy relies on a combination of routing and speed options, and tailored to conditions of geographic in metropolitans' areas. Many existing research studied and present the strategy that applied with many industries such as automotive, textile, consumer products, and manufacturing. This paper will explore and illustrate the model that is increasing vehicle utilization and improving transport efficiency, which is considering how delivery vehicles might be used to collect waste and/or return goods.

The proposed model will be adapted to each area's likely right whale occurrence. The strategy also recommends continuing support for existing protective actions and examines the proposed model to serve the modern customers are now even more demanding as a response, logistics delivery and service criteria are enablers of competitive advantage.

## 1.2 Research Objectives

This research aimed to study and explored green innovations and to tailor logistical activities that had the potential to become the next element of strategy as an inventive way of creating value for customers and sustainable growth for pharmaceutical logistics service providers in Thailand. The objectives of the researches were following;

1. To review the existing research regarding green innovation, supply chain management, supply chain practices, logistics, distribution and lean model that reduce total costs and improve customer service levels.
2. To understand and analyze activities that need to be addressed and was essential to implement green innovations for pharmaceutical logistics service providers, including product owners, distributors, wholesalers, and retailers.



3. To identify which green innovation strategy, tailor activities and lean logistics philosophy can be applied and utilized by pharmaceutical service providers.

4. To examine and develop a green logistics model that was tailored for pharmaceutical distribution company including order process, ordering mistake-proofing, logistics procedures that lead to cost-effectiveness and smooth delivery (efficiency, speed, routes and delivery reliability) to customers, and energy saving that can reduce the carbon emission.

5. To examine the fit of the proposed model of tailor made logistics activities for the pharmaceutical services providers.

### 1.3 Research Scope

This research aimed to explore green innovation including green definition, green supply chain management, supply chain management practices, green innovation practices, tailored logistics, lean principles in service sectors and to establish the likely associated operational models. As in Figure 11, the study also investigated operational flexibility, product categories, and order cycles, work in a shared data environment, technology sharing and logistics activities which focus only on outbound activities, and then analyzing and evaluating the factors that influence improvement in the company environmental performances. In addition to explore the green strategy and tailor strategy collaborate with lean concept were right for the Thai pharmaceutical service provider. The next section observed the implementation of the proposed model within ordering process and outbound activities that reduce administration and distribution costs by consolidating, taking advantage of economic of scale and streamline transportation routes. The results were also analyzed and validated through the improvements of work efficiency, accuracy, and Key Performance Indicators (KPI) as a measurement tool based on the guideline of the ISO 14031 and GSCM/PM

concepts (Hervan, Helms and Sarkis, 2005). The last section analyzed data and results with conclusions.

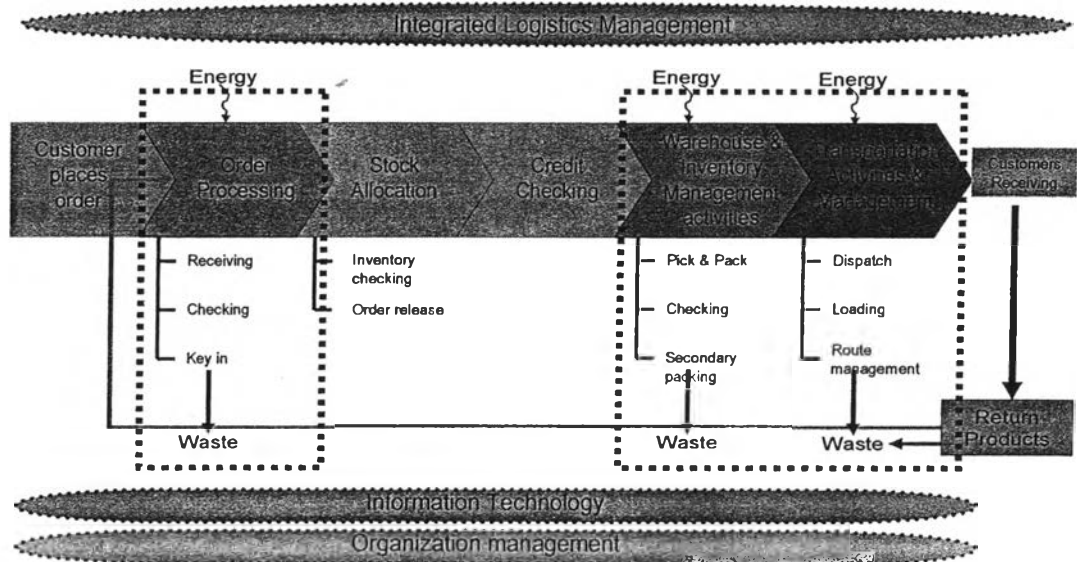


Figure 11: Overview of current operations and logistics procedure of the case study and scope of study

### 1.4 Research Framework

This research focused to observe and examine the green concept in private sector company by applying the proposed model tailor made logistics activities for the pharmaceutical service supply chain management system that would be increase working efficiency through KPI as it presented in Figure 12 below.

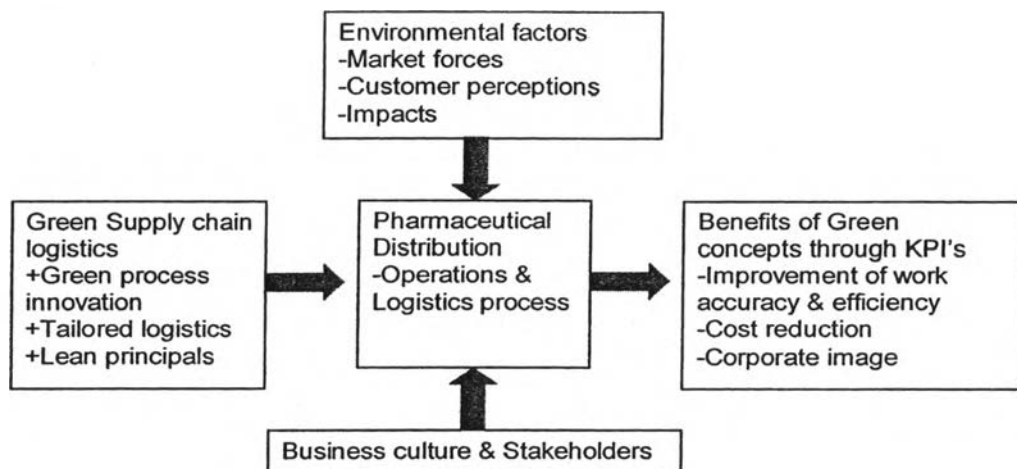


Figure 12: A Conceptual Framework

### 1.5 Conceptual Model Study

This research focused to examine the fit of the proposed model of tailor made logistics activities for the pharmaceutical services supply chain management system. The model created base on observing the current practices of pharmaceutical service providers and literature review related to green supply chain management study, green process innovation and value chain analysis. Setting and measuring Key Performance Indicators (KPI) based on the guideline of the ISO 14031 and GSCM/PM concept

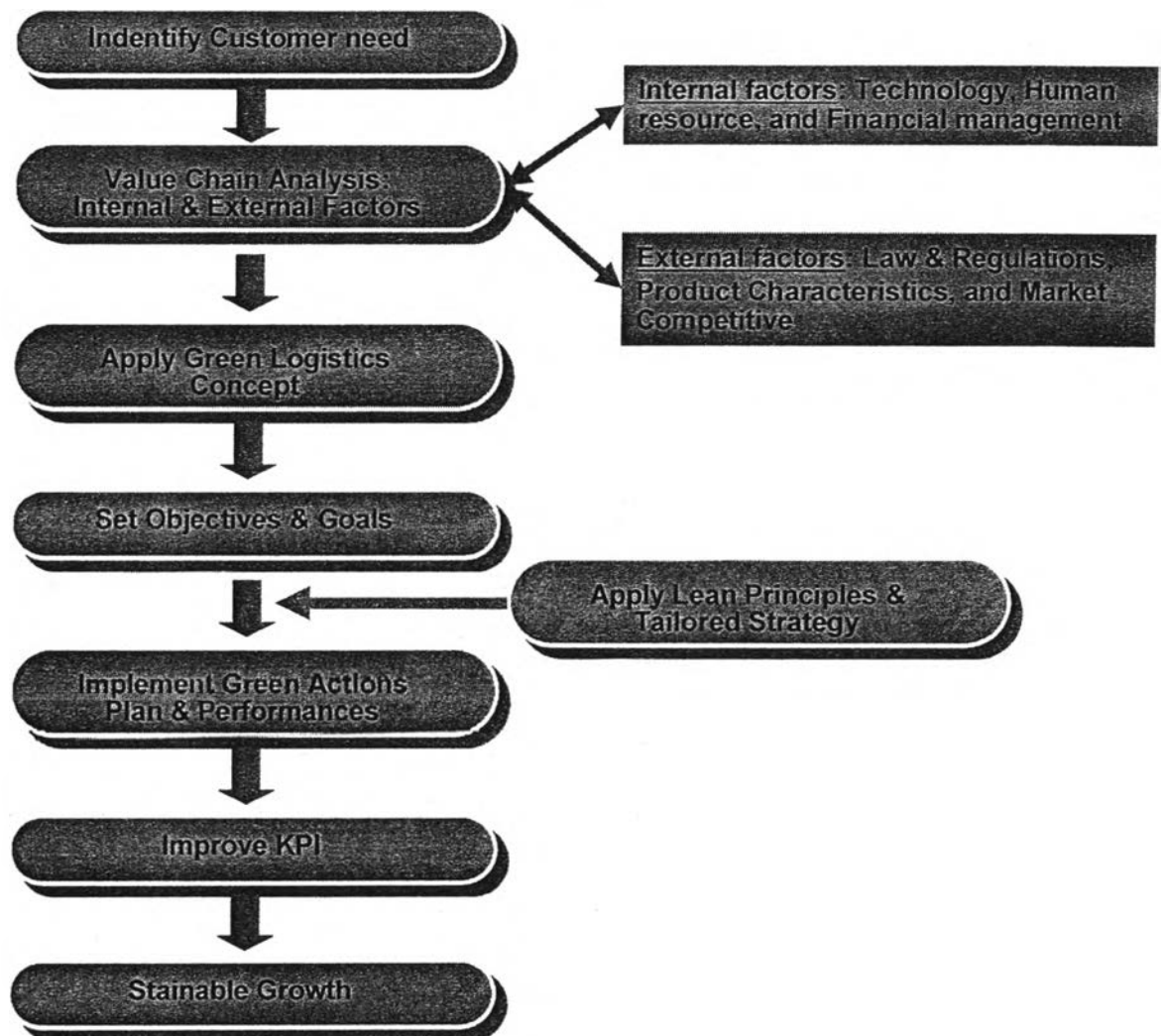


Figure 13: The proposed model base on green process innovation concept

### 1.6 Key Words

Green process innovation, supply chain management, tailor logistics, sustainable development, lean logistics model, green supply chain management performance measurement (GSCM/PM)

### 1.7 Expected Outcomes of the Study

1. Eligible to apply different green activities by implementing the proposed model, collaborate with ordering process and outbound logistics activities in a pilot company in a pilot project: "Green Innovation Solutions with a Tailored Strategy"

2. Key Performance Indicators (KPI) related to the improvement of company environmental performance based on the guideline of GSCM/PM and ISO 14031 of the pharmaceutical distributor was improved by applying the proposed model.

3. The logistics activities addressed by implementing the proposed model were accepted by other stakeholders of pharmaceutical service providers.

### 1.8 The Expected benefits of the study

1. The research could illustrate the green activities that improve organization environmental performance that effected cost reduction and service levels.

2. Applying the proposed model would lead the pharmaceutical service providers to gain competitive advantages in term of cost reduction and reduce environment impact.

3. This research could illustrate the proper green logistics practices for other stakeholder to see the opportunities to improve environmental performance.

4. The research resulted of this case study would be applicable to other Thai pharmaceutical logistics service providers.

### 1.9 Research Methodology

The research process began with the generation of idea from a literature review to provide a historical perspective of the respective research area and a case study observation in order to establish general principles for exploring, investigate, and generated a new understanding (Voss et al., 2002). According to the data gathering from available secondary data of the Thai health care industry, all stakeholders, such as pharmaceutical manufacturers, distributors, hospitals, clinics, drug stores and healthcare institution are connected along the supply chain system and create an impact on the environment, which logistics distributors are one key factor regarding operations and logistics activities and as a center of networking. The exploratory case study was conducted within one of Thai leading pharmaceutical distributor to understand the current practice among pharmaceutical logistics service providers and the key impact factors to environment and the performance outcomes.

Step 1: Collect relevant information:

Secondary data: Literature Review and secondary data

Primary data: Observation case study current practices.

Step2: Analyze and define the appropriate model and determine KPI related to GSCM/PM

Step 3: Implement the proposed model

Step 4: Measurement of the result according to KPI

Step5: Extending the proposed model to other stakeholders by conducting depth-interview

Step 6: Conclusion

As collecting relevant information, the paper began with a literature review of green logistics, green innovation, lean model, and tailored logistics which led to the development of research framework and established the proposed model. This research focused on detail information on the practices of pharmaceutical operations and logistics process and activities related to the carbon emission.

Besides the data gathering from literature review and exploratory research, the methods of research such as clustering, categorization and cross-comparison have been applied. The study focused on the observation of the case study company practices to highlight the degree of lean model utilization within pharmaceutical logistics service providers and tested the proposed model. This was followed by interviewing the relevant and key personnel involved in lean implementation. The results were analyzed and validated through workshops and case studies. The measurement of their outcomes through KPI related to GSCM/PM and ISO 14031 guidelines. Then extending this proposed model to other stakeholders and collecting the data by using the structured interviews with experts in the field of a pharmaceutical provider and top industry executive and drugs owners. A total of 20 interviews were conducted. In order to gain sufficient depth as well as width in the research, more details including the perception, strategy, green activities and logistics model that lead to logistics innovation methods investigated were investigated.

The sampling frame of the research design comprised an ISO 14000 certified pharmaceutical distribution company in Thailand and other top ten healthcare services provider based on value and volume of logistics transactions comprising 10 expertise of distributors and hospitals managers and 10 other drugstores by depth interviews. This study used the convenient samples by using the snowballing technique

regarding the efficiency and effectiveness in identification of suitable interviewees. It also reduced difficulty and cost (Moriarty, 1983)